APPENDIX D

SUMMARY OF HISTORICAL SURFACE WATER DATA

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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
AWQC	ambient water quality criteria
CCME	Canadian Council of Ministers of the Environment
CEQG	Canadian Environmental Quality Guidelines
COI	chemical of interest
DOC	dissolved organic carbon
Ecology	Washington State Department of Ecology
EIMS	Environmental Information Management System
EPA	U.S. Environmental Protection Agency
ESI	expanded site inspection
LDPE	low-density polyethylene
LRFEP	Lake Roosevelt Fisheries Evaluation Program
MCL	maximum contaminant level
MRL	method reporting limit
NASQAN	National Stream Quality Accounting Network
ORP	oxidation-reduction potential
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-*p*-dioxin
PCDF	polychlorinated dibenzofuran
RI/FS	remedial investigation and feasibility study
RM	river mile
SEV	screening ecological value
SLERA	screening level ecological risk assessment
SPMD	semipermeable membrane device
SVOC	semivolatile organic compound
TAL	target analyte list
TCM	Teck Cominco Metals Limited
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
UCR	Upper Columbia River
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
VOC	volatile organic compound

1 INTRODUCTION

This appendix contains a summary and evaluation of historical surface water data for the Upper Columbia River (UCR). The purpose of this review is to assess existing information on surface water to support the data quality objective and study design process. This review also provides the basis for the identification of data gaps. This discussion of findings from past studies and monitoring efforts serves as a primary basis supporting the identification of major data gaps and development of data collection activities related to surface water in the UCR. Information from selected U.S. and Canadian studies and monitoring programs is presented. Data collection activities occurring north of the U.S.-Canadian border, although technically outside of the defined extent of the UCR site, are valuable for understanding temporal and spatial variability in chemical concentrations in various UCR media and biota.

The following sections provide:

- Section 2—A summary of UCR hydrology
- Section 3—An overview of potential and known sources of chemicals of interest (COIs) to the UCR
- Section 4—A summary of existing data on surface water
- Section 5—Interpretation of metals distributions in the UCR and tributaries
- Section 6—Interpretation of organic chemical distributions in the UCR and tributaries
- Section 7—An overview and interpretation of selected conventional analytes and measurements
- Section 8—An overview of the preliminary results of the screening level ecological risk assessment (SLERA) related to surface water
- Section 9—Data gaps
- Section 10—References.

A summary of the surface water data discussed here is provided in Section A5 of the main text of the quality assurance project plan.

2 HYDROLOGY

The history of water level and flow management in the UCR is described in Section 3.2.3 of the UCR remedial investigation and feasibility study (RI/FS) work plan (USEPA 2008). Currently the annual water regime is characterized by a period of water level drawdown in the winter and early spring, a period of refilling during spring snowmelt, and a smaller late summer drawdown to facilitate the downstream migration of juvenile salmonids (Figure 1).

The greatest influence on water level elevation in the UCR is the flood control operations at Grand Coulee Dam, followed by operations of Canadian dams upstream of the Site. Flood control targets on the Columbia River in the U.S. are a function of projected runoff at The Dalles, which varies from year to year.

The wide annual variation in runoff strongly influences the extent of reservoir drawdown, resulting in a range of pool elevations as shown in Figure 1. In years with little runoff, spring drawdown can be limited to roughly 15 ft below full pool elevation (1,290 ft above mean sea level [amsl]), while in years of high runoff, the spring drawdown will take the reservoir down to minimum operating pool elevation of 1,208 ft amsl, a full 82 ft below full pool. As a result of varying pool control, water retention time in the reservoir also varies widely among years—from a spring minimum of 30 days during low runoff years to 12 days during high runoff years.

3 SOURCES OF CHEMICALS OF INTEREST TO THE UCR

Numerous historical and current point and nonpoint sources may contribute COIs, primarily metals, to the UCR (Lake Roosevelt Water Quality Council 2000; Orlob and Saxton 1950). These sources include discharges from the Teck Cominco Metals Ltd. (TCM) facility in Trail, British Columbia (B.C.), other industrial and municipal activities in Canada, and industrial, municipal, and agricultural activities on the UCR and its tributaries, especially the larger tributaries including the Pend Oreille, Kettle, Colville, Spokane, and Sanpoil rivers.

Historical releases from the TCM facility included permitted granulated slag and effluent discharges from smelting operations (see Section 4 and Appendix D of the UCR RI/FS work plan). Ore mining and mineral processing has been occurring in the UCR region, in both the U.S. and Canada, since at least the late 1800s. Most of the operations in the U.S. took place in Stevens and Ferry counties, including the former Le Roi smelter in Northport, Washington, which operated intermittently between 1896 and 1922 (Orlob and Saxton 1950; Wolff et al. 2005; USEPA 2003). The Le Roi smelter, and numerous other mine and mill sites in Stevens and Ferry counties, have been investigated by regulatory agencies over the past decade. Several were found to have been sources of confirmed releases to environmental media that may have impacted the UCR site.

Additional potential point and nonpoint sources of chemicals to the UCR include the following:

- A variety of industrial operations that are or were present in the vicinity of the UCR and its tributaries. Recent operations were identified in the revised work plan based on the Toxic Release Inventory, the National Pollutant Discharge Elimination System, the Washington State Department of Ecology's (Ecology) Confirmed and Suspected Contaminated Sites List, and the Canadian National Pollutant Release Inventory.
- Municipal wastewater treatment plants that discharge into the Columbia, Pend Oreille, Colville, Spokane, and Sanpoil rivers (Bortleson et al. 2001).
- The Stevens County Sanitary Landfill (operational since July 5, 1979) near the Town of Kettle Falls (Stevens County 2007). As the only municipal solid waste landfill in the area, it serves all of Stevens County and portions of Ferry County.
- Potential nonpermitted discharges and spills to the UCR and tributaries.
- The Spokane River, which is a known source of several metals and polychlorinated biphenyls (PCBs) to the UCR (Clark 2003; Johnson et al. 1994;

Kadlec 2000). Recent investigations of the Spokane River have also identified elevated levels of polybrominated diphenyl ethers (PBDEs) in fish tissues relative to other locations throughout Washington (Johnson et al. 2006; Serdar and Johnson 2006). Specific sources of PBDEs in the Spokane River have yet to be identified.

- Agricultural runoff, which is a potential source of nutrients and pesticides to surface water (Vellidis et al. 2003).

Contaminated sediment potentially deposited along the banks and within the channel of the UCR may also serve as a secondary source of contamination to surface water, particularly for metals.

4 EXISTING SURFACE WATER DATA

This section describes available water data for the UCR. Data currently in the UCR surface water database have come primarily from the U.S. Geological Survey (USGS) and its National Water Information System, Ecology's Environmental Information Management System (EIMS), Environment Canada's Federal/Provincial water quality monitoring program, and various other monitoring studies.

4.1 METALS

The list of metals/metalloids identified in the UCR RI/FS work plan as COIs for the site include 61 elements, including all U.S. Environmental Protection Agency (EPA) target analyte list (TAL) metals[1] and a large number of less common metals that may occur as trace constituents of mineralized ores and that have been the subject of previous investigations in the UCR (Table 1).

Data sets that include metal concentrations in surface water of the UCR, tributaries to the study area, and the Columbia River in Canada are listed in Table 2. The locations of stations with recent (post-1995 data) discussed in this appendix are shown on Map 1.

4.2 ORGANIC COMPOUNDS

Organic COIs identified in the RI/FS work plan (USEPA 2008) are listed Table 3. Data for organic COIs within the UCR are limited spatially and temporally. One surface water sample from Lake Roosevelt just upstream of the City of Grand Coulee drinking water intake was collected in 2001 as part of the UCR expanded site inspection (ESI) and was analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), chlorinated pesticides, PCBs (Map 2). Pesticides and herbicides were analyzed in surface water samples collected by the USGS at Northport, Washington, from 1995 through September 2000 (Map 2; http://nwis.waterdata.usgs.gov/wa/nwis/), polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) analyzed by Ecology and USGS in samples collected at Northport in 1992 and 1993 (Serdar et al. 1994), and PBDEs analyzed in semi-permeable membrane devices (SPMDs) deployed near Marcus Flats in 2005 and 2006 (Johnson et al. 2006).

[1] TAL metals consist of aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

4.3 CONVENTIONAL ANALYTES

Conventional chemical and physical parameters/analytes of interest for the UCR RI/FS include the following:

- Alkalinity
- Major ions (sodium, calcium, magnesium, fluoride, chloride, sulfate)
- Conductivity
- Total and dissolved organic carbon (TOC and DOC)
- Dissolved oxygen
- Hardness
- Oxidation-reduction potential (ORP)
- pH
- Temperature
- Total suspended solids (TSS)
- Total dissolved solids (TDS)
- Turbidity

Available data sets were reviewed to identify sample locations where multi-year measurements of these parameters had been made in the UCR study area. Six locations on the UCR were identified that have multiple years' data for several of the target parameters (Map 3):

- Northport: Columbia River at Northport (USGS Station 12400520; Ecology's Station 61A070 at River Mile (RM) 735.1)
- Kettle Falls: FDR Reservoir at Kettle Falls (U.S. Bureau of Reclamation [USBR] Site ID FDR005; vertical profile monitoring station)
- Spokane River at Mouth (Ecology Station ID 54A050)
- Lincoln Boat Ramp: FDR near Lincoln Boat Ramp (USBR Site ID FDR008; vertical profile monitoring station)
- Keller Ferry Boat Ramp: FDR near Keller Ferry Boat Ramp (USBR Site ID FDR008; vertical profile monitoring station)
- Logboom: FDR at Logboom (USBR Site ID FDR010; vertical profile monitoring station).

Additional data for certain conventional parameters (e.g., temperature, pH, dissolved oxygen, alkalinity, TSS, turbidity, hardness) have been collected from the Lake Roosevelt reservoir as part of the Lake Roosevelt Fisheries Evaluation Program (LRFEP) (Lee et al. 2006). These data are available in several reports (as listed in Lee et al. 2006); some are discussed in Section 7.

4.4 NUTRIENTS

Nutrients in UCR surface water include ammonia, nitrate, and phosphorus. Nutrients have been monitored at the USGS and Ecology stations near Northport from the 1950s to the present, and at the station in the mouth of the Spokane River from 1990-1994. Other historical nutrient data sets are available for the UCR from numerous monitoring studies. Nutrient data are also available from stations outside the boundaries of the UCR such as the tributary stations listed above, and from the Birchbank and Waneta monitoring stations in British Columbia.

A number of data quality issues were identified during the compilation and preliminary evaluation of the historical nutrient data, primarily due to ambiguity in the terminology used for the reported results among studies (e.g., ammonia may be reported as ammonia in USGS data, but as nitrogen in the Ecology data) and in the analytical methods used. Consequently, the evaluation of spatial and temporal trends in nutrient concentrations was not conducted at this time.

5 METAL DISTRIBUTIONS IN THE UCR AND TRIBUTARIES

Metals/metalloid data are only available for a subset of the metals on the COI list, largely at a single location, Northport. This section describes available metals and metalloids data for the UCR and its tributaries.

Although metals are ubiquitous in surface water, sediment, and soil, meaningful measurements of detected levels in surface water have only been possible with the advent of clean sampling techniques that minimize handling contamination and analytical methods that achieve detection limits low enough to characterize metal/metalloid concentrations in natural systems. For the UCR, the most useful data have been collected since 1995, when the USGS National Stream Quality Accounting Network (NASQAN) made substantial improvements to sampling methods and analytical methods.[2] Even so, notable improvements in detection limits are also observed beginning in 2001 (discussed below).

5.1 METALS DATA FROM THE COLUMBIA RIVER: BIRCHBANK TO NORTHPORT

Total metals are monitored at several locations in the Columbia River and Pend Oreille River, a major tributary to the UCR just north of the border, in B.C. Stations in the main stem of the Columbia River in B.C. include the Columbia River at Birchbank station (Federal ID BC08NE0005/Provincial ID 200003), approximately 10 km (6 miles) upstream of the Trail facility, and the Columbia River at Waneta station (Federal ID BC08NE0001/Provincial ID 200021), located downstream of the smelter, approximately 2.5 km (1.5 miles) upstream of the U.S.-Canadian border. Additional data are available from the Pend Oreille River at Waneta B.C. (Federal ID BC08NE0029/Provincial ID 200021) and further upstream at a site referred to as “International Boundary” (Federal ID BC08NE0020/Provincial ID E237493) also located in B.C. just downstream of the U.S. border (Table 2). The Pend Oreille River enters the Columbia just downstream of the Columbia River at Waneta sampling station.

Box plots of surface water data from the four B.C. locations were developed for comparison of detected total metals concentrations to those measured at Northport, Washington, from 2001 through 2005 (Figures 2 through 6). The box plots are based only on detected metal concentrations so that differences in detection limits do not

[2] Personal communication with Steve Cox on December 13, 2007, regarding the timing of changes to the NASQAN program that affected data quality.

influence comparisons of metal concentrations between stations, although detection frequencies at the four B.C. sites were very high for all metals evaluated here (mercury data are not available for the B.C. locations during the period 2001–2005). At Northport, however, cadmium and zinc were infrequently detected (detection limits at Northport were higher than those achieved at the B.C. sites). The following summarizes the overall trends by metal.

- **Arsenic:** Total arsenic concentrations in the Columbia River at Birchbank and Waneta were comparable (see Figure 2). Total arsenic concentrations at the two Pend Oreille River sites are approximately 4 to 5 times greater than in the Columbia River at Birchbank and Waneta (see Figure 2). At Northport, total arsenic concentrations are intermediate between those measured in the Columbia upstream of the border and those measured in the Pend Oreille River (see Figure 2).
- **Cadmium:** Total cadmium concentrations in the Columbia River at Waneta are approximately two-fold higher than those measured at Birchbank and the Pend Oreille River (see Figure 3). Total cadmium was detected at Northport in only one of 26 samples from 2001 through 2005. The detection limit (0.1 μg/L) was higher than the concentrations detected at the B.C. sites, thus precluding any concentration comparisons between Northport and the upstream sites.
- **Copper:** Total copper concentrations are generally, although not substantially, higher in the Columbia River at Waneta than at Birchbank (see Figure 4). Total copper concentrations in the Pend Oreille River are higher than those measured in the Columbia at Waneta. Copper concentrations at Northport are similar to those measured in the Pend Oreille River or intermediate between those measured in the Columbia at Waneta and the Pend Oreille River (see Figure 4).
- **Lead:** Total lead concentrations were not highly variable between the B.C. sites and Northport, although concentrations are slightly higher in the Pend Oreille River at Waneta than those measured in the Columbia River at Waneta (see Figure 5). The range in total lead concentrations at Northport tended to overlap more with the range in concentrations measured in the Pend Oreille River at Waneta (see Figure 5). However, overall variability in total lead concentrations was not large (less than a factor of two) among all sampling locations.
- **Zinc:** Overall, total zinc concentrations were higher in the Columbia River at Waneta than upstream at Birchbank, and total zinc concentrations in the Pend Oreille River were intermediate between those measured in the Columbia at Waneta and Birchbank (see Figure 6). At Northport, total zinc was infrequently detected at a detection limit of 5 μg/L, which is higher than the majority of

detected concentrations at the B.C. sites. Thus, it is not possible to adequately compare total zinc concentrations at Northport versus the upstream sites.

5.2 METALS DATA AT NORTHPORT

Only one station within the study area provides long-term data for metals concentrations in surface water: the Columbia River at Northport, Washington (USGS Station 12400520; Ecology Station 61A070 at RM 735.1), located approximately 10 miles downstream of the U.S.-Canadian border. Summary statistics for total and dissolved metals results from this station are provided in Table 4. Total metals concentrations most frequently detected (i.e., detected in 75 percent or more of the samples analyzed) include arsenic, copper, lead, and nickel. The most frequently detected dissolved metals are barium, calcium, copper, magnesium, potassium, sodium, strontium, and zinc.

Arsenic, cadmium, copper, lead, mercury, and zinc are considered to be representative of the UCR metal COIs, for the purposes of this discussion. Cadmium, copper, lead, mercury, and zinc are all associated with historic and/or present releases from the TCM facility in Trail, B.C. Available dissolved and total recoverable concentrations of these representative metals in surface water data from Northport (i.e., January 1995–June 2007) are presented in Table 5 and plotted as a function of time in Figures 7 through 12. In each figure, closed symbols represent detected concentrations and open symbols represent the detection limit for undetected concentrations. For many metals, an improvement (decrease) in detection limits in 2001 leads to an improvement in data interpretability.

Focusing on post-2000 data, these trends in metals concentrations indicate that:

- Elevated detection limits for total cadmium and total zinc constrain data interpretation for data collected after 2001
- Only one metal in dissolved form, cadmium, exceeded chronic ambient water quality criteria (AWQC) at one sampling event
- Copper exceeded the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) value (as total copper) once (June 2003)
- Total zinc exceeded the CCME CEQG screening value once (June 2003)
- Total lead exceeded the CCME CEQG screening value once (December 2005)
- Metal concentrations at Northport are generally most variable in the spring and most stable in the late summer and early fall.

The potential relationships to season and flow were examined by plotting measured concentrations along with available flow data reported by Ecology based on a stage-discharge rating curve (Figures 13 through 18).

Total and dissolved arsenic, total copper, and total lead data suggest that there may be seasonal patterns in concentrations. Arsenic, which is primarily in dissolved form, has concentration decreases that tend to occur during the late winter or spring (April or June) and correspond to increases in flow. Total copper tends to reach annual maximum concentrations in the spring (April or June) and minimum concentrations in the fall (October), and generally increases with flow. No seasonal pattern is apparent from the dissolved copper data. Overall, total lead concentrations tend to be low in the winter (December or February), rise in the spring months to reach maximum concentrations in June, and then decrease by October. No seasonal pattern is apparent in the dissolved lead data. Although concentrations may vary, the variation was almost always less than one order of magnitude.

5.3 METALS DATA FROM LRFEP

Analytical results for surface water samples collected from several locations in the UCR from 1998 to 2000 by LRFEP have recently been published (Scofield and Pavlik-Kunkel 2007). The study and findings of Scofield and Pavlik-Kunkel (2007) are summarized below.

Surface water samples were collected from eleven locations within the reservoir portion of the UCR: Evan's Landing (RM 710); Kettle Falls (RM 701); Gifford (RM 674); Hunters (RM 661); Spokane River Confluence (RM 639); Seven Bays (RM 636); Sanpoil River Confluence (RM 616); Keller Ferry (RM 615); Spring Canyon (RM 600); Porcupine Bay (RM 638); and Sanpoil River (within Sanpoil Arm, RM 617) (Map 1). Samples were collected monthly over the period of January 1998–March 2000, using a Van Dorn bottle (1998) and depth-integrated water sampler (1999–2000) (Scofield and Pavlik-Kunkel 2007). The Van Dorn bottle samples were collected from mid-depth of the photic zone, and 1 m below the photic zone (Scofield and Pavlik-Kunkel 2007). Samples collected with the integrated sampler were collected from the surface to the bottom of the photic zone. Both samplers were weighted with lead weights (Scofield and Pavlik-Kunkel 2007).

The samples were submitted to the Spokane Tribal Laboratory for total recoverable trace element analysis by inductively coupled atomic emission spectrometry Method 200.7 (arsenic, cadmium, copper, and zinc), graphite furnace atomic absorption Method 200.9, and cold vapor atomic absorption spectrometry, Method 245.1 (mercury) (Scofield and Pavlik-Kunkel 2007).

Summary statistics of the analytical results are provided in Table 6 (Scofield and Pavlik-Kunkel 2007). As shown, frequencies of detection were low for most metals, except lead (Table 6). The authors note that generally high detection limits and the use of lead weights on sampling equipment were two aspects of their study that impacted the usefulness of the resulting data, and the lead results in particular are considered questionable due to possible contamination (Scofield and Pavlik-Kunkel 2007).

A synopsis of Scofield and Pavlik-Kunkel's (2007) results is provided below for key trace metals.

- **Arsenic** (n=608). Total arsenic concentrations exceeded the method reporting limit (MRL)[3] in 15 of 608 samples. None of the samples exceeded the AWQC. The authors note that spatial and temporal trends were not distinguishable because of the small number of detected concentrations but that 6 of the 15 measured concentrations occurred in Porcupine Bay, which is located within the Spokane Arm of the river system.
- **Cadmium** (n=608). Total cadmium concentrations exceeded the MRL in only 1 percent (8 of 608) of the samples. These samples were located at or upriver from Seven Bays.
- **Copper** (n=520). Temporal and spatial patterns in total copper concentrations were not evident among the 14 of 520 samples that exceeded the MRL. Measureable copper concentrations occurred from Evans Landing to Spring Canyon. The highest concentrations were reported at Spring Canyon and Keller Ferry.
- **Lead** (n=608). Total lead was detected in 402 of 608 samples located throughout the study area. Because use of a lead weight on the sampling apparatus may have contaminated some of the samples, the authors believe the results are questionable. Consequently, the data are not evaluated further.
- **Mercury** (n=544). Only one of 544 total mercury samples was above the MRL. This sample was located at Spring Canyon.
- **Zinc** (n=608). Total zinc was measured at or above the MRL in 92 of 608 samples located throughout the study area. Log-transformed zinc concentrations at

[3] Any deviation from the ideal laboratory sample results in a method reporting limit (MRL), which is the corrected concentration reportable for that sample under those conditions. The MRL is always equal to or greater than the method detection limit (MDL). Under ideal conditions, the analytical system provides the lowest concentration that can be reported, while minimizing uncertainty due to matrix effects. This concentration is the MDL. MRLs were not reported by Scofield and Pavlik-Kunkel (2007).

Porcupine Bay were significantly greater (p=0.0079 or less) than those in samples from Evan's Landing, Kettle Falls, Gifford, Hunters, Seven Bays, Spring Canyon, and the Sanpoil River.

5.4 METALS DATA FROM TRIBUTARIES TO THE UCR

Downstream of Northport, major tributaries flow into the UCR, including the Kettle, Colville, Spokane, and Sanpoil rivers. Concentrations of total and total recoverable metals for these rivers were compared to the concentrations found in the UCR at Northport (with the exception of the Colville River, for which no metals data are available for the 1995–2007 period). Comparisons were based on total recoverable concentrations because they are more indicative of relative loading potential. As shown in Figures 19–24, the available metals concentration data for the Kettle, Spokane, and Sanpoil rivers are comparable to the UCR at Northport.

6 ORGANIC CHEMICALS OF INTEREST

Analysis of organic chemicals in UCR surface water has included analyses of VOCs, SVOCs, pesticides and herbicides, PCBs, PCDDs, PCDFs, and PBDEs, although the distribution of these samples is spatially and temporally limited.

One surface water sample was collected from Lake Roosevelt near the city of Grand Coulee as part of the UCR ESI in 2001. Analytes for the sample included VOCs, SVOCs, pesticides, and PCBs. The results of all organic constituents were below detection limits (USEPA 2003).

Pesticides and herbicides were analyzed in surface water samples collected by the USGS at Northport, Washington, from 1995 through September 2000 (Map 2; Paulson et al. 2006). The results are summarized in Table 7. Nearly all of the results were below detection limits with no quality control information.

In 1992, Bortleson et al. (2000) measured dioxin and furan concentrations in the water column (using XAD resin columns) and suspended sediment at Northport, and in effluent from the Celgar Pulp Company (located upriver of the TCM facility). Dioxins were detected in each type of sample while furans were detected in the suspended sediment and effluent samples. The 2,3,7,8-TCDD congener was not detected in any Northport sample but was detected in the effluent sample.

PCDDs and PCDFs were analyzed in samples collected at Northport in 1992 and 1993 in a joint study by Ecology and USGS (Serdar et al. 1994). This study's focus was on the association of dioxins and furans with suspended particulate matter. However, some analyses were conducted on dissolved samples. The dissolved samples were derived by filtering centrifuged water through XAD™ resin columns. Three PCDDs and seven PCDFs, including 2,3,7,8-TCDF, were detected in dissolved samples in this study. The authors concluded that there was a significant decrease in 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations between 1990 to 1993 that coincided with modifications at the Zelstoff Celgar pulp mill. No other data have been found for dioxins in UCR surface water.

Finally, PBDEs were the focus of a statewide study in 2005 and 2006 (Johnson et al. 2006). Samples collected from near Marcus Flats were analyzed for PBDEs as a part of this study. All samples were collected with SPMDs and reported as sample concentration in nanograms per SPMD (Johnson et al. 2006). An SPMD consists of a tubular, layflat, low-density polyethylene (LDPE) membrane containing a thin film of a high-molecular weight lipid surrogate (triolein). The LDPE tubing mimics a biological membrane by allowing selective diffusion of hydrophobic organic compounds into the lipid. SPMDs sequester the dissolved form of a chemical and provide lower detection limits than traditional water sampling techniques. The SPMDs were deployed in the UCR from September 8 to October 6, 2005 (Johnson et al. 2006). PBDEs were detected as PBDE-47, PBDE-99, and total PBDE in the samples collected by this method (Johnson et al. 2006). Concentrations of these three PBDEs in the dissolved phase were estimated using known octanol–water partition coefficients (K_{ow}s). Estimated total PBDE concentrations were 16 pg/L in the UCR (Johnson et al. 2006). There are no other surface water data for PBDEs in the UCR.

The Johnson et al. (2006) study also deployed SPMDs in the Spokane River at Ninemile Dam, in the fall of 2005 (September 8–October 6) and spring of 2006 (March 23–April 26). Seven PBDE compounds were each detected in both the fall and spring samples (PBDE-47, -49, -66, -99, -100, -153, and -154). Concentrations of the detected PBDEs in the dissolved phase were estimated using known K_{ow}s. Total PBDE concentrations were estimated at 926 pg/L in the fall sample and 146 pg/L in the spring sample. The authors attributed this apparent seasonal variation to possible dilution of local source contributions by snowmelt runoff in the upper watershed (Johnson et al. 2006). In comparison to the estimated total PBDE concentration detected in the fall 2005 sample from Marcus Flats mentioned above, the authors state that the results of the Ninemile Dam samples indicate that the Spokane River may be a relatively significant source of PBDEs to the UCR.

7 CONVENTIONAL WATER QUALITY PARAMETERS

Recent (post-2000) data are available for several conventional water quality parameters in the study area (conductivity, dissolved oxygen, hardness, ORP, pH, temperature, TSS, and turbidity), but are lacking for many other parameters (alkalinity, calcium, chloride, DOC, fluoride, magnesium, sodium, sulfate, TDS, and TOC). Multi-year data for conventional parameters are available from six stations within the UCR Site (Northport, Spokane River at mouth, and the four USBR monitoring stations). Summary statistics of conventional water quality parameter data for the study area sampling locations mentioned above are presented in Table 8.[4]

Recent long-term vertical profile data for conventional parameters between Northport and Grand Coulee Dam are limited to the USBR Kettle Falls, Lincoln Boat Ramp, Keller Ferry Boat Ramp, and Logboom stations. Vertical profile measurements of ORP, pH, conductivity, temperature, and dissolved oxygen from these stations from the period 2002–2006 were provided by USBR. These data were generally collected once a month from April to October.

Field measurements of particular interest to the UCR RI/FS include conductivity, temperature, oxygen and total dissolved gas, and pH. Conductivity and temperature are important variables that affect or may be indicative of vertical stratification and mixing. Conductivity is also an indication of major ion content. Oxygen and pH are relevant to water quality, biological process, and metal geochemistry.

7.1 CONDUCTIVITY

Conductivity is a measure of major ion content of surface water. The anion and cation content of surface water reflects that of the source water, including rainfall, runoff, and groundwater infiltration.

Profiles of conductivity measurements collected at the four USBR stations are presented in Figures 25 through 28). The strongest seasonal change in conductivity was observed at the most upstream sampling location, Kettle Falls, although the magnitude of seasonal changes varies from year to year (Figure 25). Vertical stratification in conductivity is also indicated at some downstream stations.

[4] Available data for lateral distributions of conventional water quality parameters are limited to transect stations dating from April to May 1972 (NPS 1995); because of the age and the limited temporal coverage of those data, they are not discussed here.

7.2 TEMPERATURE

Temperature conditions of Lake Roosevelt have not substantially changed since the 1970s according to available data. Ecology routinely monitors water quality parameters, including water temperature, immediately upstream from Lake Roosevelt (Station 61A070 at RM 735.1) and immediately downstream from the reservoir (Station 53A070 at RM 596.0).

Figure 29 provides an example of temperature conditions in Lake Roosevelt and the changes that occur from the U.S.-Canadian border to the Grand Coulee Dam forebay. This information shows approximately a 30- to 40-day shift in the comparable water temperatures between the border and the dam forebay.

Although Lake Roosevelt experiences substantial flows (i.e., commonly 40,000 to 200,000 cfs) and changes in surface elevation, a weak thermal stratification of the water column can occur during the summer when solar radiation heats the surface water (Jaske and Snyder 1967; USFWS 1969). During periods of the weak thermocline, temperatures of the water below the thermocline are commonly in the range of 14 to 19°C (57 to 66°F). However, in an exceptionally high flow year, the temperature differential between surface and deeper water has been substantially less (Sylvester 1958). In autumn, the water temperature characteristics change, with longitudinal variation exceeding vertical variation (USEPA 1971).

Plots of temperature measured at the four USBR monitoring stations from 2002 to 2006 are presented in Figures 30 through 33 to show observed seasonal variations at the four locations. In these plots, the depth values were adjusted to approximate elevation using historical reservoir elevation data from the Columbia River DART database. As shown, temperature thermoclines developed at each of the stations, as early as May at the Keller Ferry and Logboom stations, but disappear by September. When they develop, maximum annual thermoclines may extend to less than 10 ft (at Kettle Falls, the shallowest of the four sites) up to approximately 40 ft (Lincoln Boat Ramp, Keller Ferry) or more (Logboom).

7.3 pH

Plots of pH measurements at the USBR stations are shown in Figures 34 through 37. In general the pH profiles are similar to temperature profiles in most years, although in some months and years, widely different patterns are shown (e.g., Lincoln Boat Ramp, 2002 and 2003, Keller Ferry, 2003). However, overall, there appear to be few seasonal pH patterns that appear consistently from year to year or from station to station. At any given location in the UCR, pH values can vary significantly with depth.

7.4 OXYGEN AND TOTAL DISSOLVED GASES

Low dissolved oxygen is commonly a water quality concern for reservoirs that develop thermal stratification during warmer months of the year. In stratified reservoirs, the subsurface waters below the thermocline (i.e., the hypolimnion) typically develop relatively low dissolved oxygen concentrations as the result of biological oxygen demand coupled with reduced exchange with the surface waters above the thermocline (i.e., the epilimnion). This trend is not observed in the UCR.

Profile plots of dissolved oxygen concentrations are shown in Figures 38 through 41. There is evidence of thermal stratification in Lake Roosevelt during the warmest months (e.g., portions of July and August) of the year. The relatively constant and substantial flow of water through Lake Roosevelt, together with the reservoir's generally low biological productivity, apparently prevents substantially reduced oxygen levels in the hypolimnion, according to the available data.

In contrast, low dissolved oxygen has been frequently detected in surface water near the bottom of the Spokane Arm during summer months. This condition has been attributed to decomposition of summer algal biomass (Stober et al. 1981; Fields et al. 2004; Lee et al. 2003; Pavlik-Kunkel et al. 2005).

Estimates of percent of saturation[5] were calculated for the USBR monitoring stations using the dissolved oxygen concentrations and temperature data reported by the USBR. The calculation was performed based on oxygen solubilities in water taken from Appendix C of Thomann and Mueller (1987), assuming a chlorinity value of zero:

$$[\mathrm{DO}]\mathrm{sat.} = (0.0044 \times [\mathrm{temperature}]^2 - 0.3623 \times \mathrm{temperature} + 14.512$$

To account for altitude, a correction factor of 1.05 was added (Horne and Goldman 1983) such that:

$$[\mathrm{DO}]\mathrm{sat.\ at\ FDR} = (0.0042 \times [\mathrm{temperature}]^2 - 0.345 \times \mathrm{temperature} + 13.821$$

The results indicate that estimated dissolved oxygen saturation ranges are similar among the four stations: from 82 to 116 percent at the Kettle Falls station, from 65 to 121 percent at the Lincoln Boat Ramp station, from 61 to 116 percent at the Keller Ferry station, and from 68 to 122 percent at the Logboom station (excluding an outlier value of

[5] Dissolved oxygen may be measured and reported as an absolute concentration (e.g., mg/L) and/or as a percentage of saturation. The percentage of saturation is important because the capacity of water to dissolve oxygen varies considerably with water temperature. At low temperatures, water will hold more dissolved oxygen at equilibrium (12.8 mg/L at 5°C) than at high temperatures (9.1 mg/L at 20°C).

154 percent that appears erroneous). During spring runoff in the UCR when total dissolved gas levels are high, dissolved oxygen also tends to be at, or greater than, saturation. However, generally during warm periods with thermal stratification and a substantial oxygen demand, dissolved oxygen levels can fall substantially below saturation.

7.5 NON-COI MEASURES OF SURFACE WATER QUALITY IN THE SITE

Longitudinal variation in water quality downstream of Northport was also evaluated using barium, potassium, sodium, silicon, and hardness data reported by Scofield and Pavlik-Kunkel (2007) from samples collected in Lake Roosevelt from Evans Landing (RM 710) to near Grand Coulee Dam at Spring Canyon (RM 600) from January 1998 through March 2000. These parameters were selected for the following reasons:

- Their concentrations in water coming into the UCR from Canada were relatively uniform (Table 9).
- Concentrations measured were similar in magnitude to those measured at Waneta (Table 10).

The data[6] for barium, potassium, sodium, silicon, and hardness suggest remarkably small spatial variation of long-term averages within the UCR (Table 10 and Figure 42a–e). For example, barium concentrations averaged 31 μg/L, but changed, on average, only 0.04 μg/L per river mile (Table 10). Likewise, hardness concentrations averaged 62.8 mg $CaCO_3$/L, but changed, on average, only 0.02 mg $CaCO_3$/L per river mile. Spatial variation in the other non-COI parameters was similarly low.

[6] The data presented by Scofield and Pavlik-Kunkel (2007) consisted only of means and sometimes standard deviations. Thus, the data given here represent these means and sometimes grand means (e.g., overall averages).

8 PRELIMINARY SCREENING RESULTS

Recent (2000–2006) surface water COI data for the UCR were screened against conservative benchmarks (TCAI 2008)[7]. Results of this screening evaluation are presented in Table 11. Of the metals monitored at Northport, Washington, by Ecology (2007b), only cadmium exceeded the screening ecotoxicity value (SEV) (i.e., ratio of 1.4) for dissolved metals in water, and that occurred only on one occasion (November 2002). The detection limit (0.1 µg/L) was relatively high, and close to the screening value of 0.19 µg/L, suggesting that there is some uncertainty as to the validity of this single exceedance. All other dissolved samples collected between 2000 and 2006 did not exceed the SEVs for the monitored analytes.

Total recoverable metal concentrations were compared to the CCME SEVs (CCME 2007), which generally are lower than SEVs based on the EPA AWQC (USEPA 2006), Washington State water quality standards (Ecology 2006), Spokane Tribe (STI 2003), or Colville Confederated Tribes (CCT 2004) aquatic life chronic criteria. Detected values of copper, lead, and zinc each exceeded their respective SEVs once in June 2003 (copper and zinc) and December 2005 (lead), with ratios of 1.5, 1.1, and 1.4, respectively. For cadmium, all 26 measurements had detection limits (0.1 µg/L) that exceeded the screening value of 0.02 µg/L. Therefore, there is insufficient information to reach a conclusion about cadmium.

Dissolved cadmium, selenium, and silver measurements in samples collected by USGS all had detection limits that exceeded respective SEVs. Therefore, no conclusions can be reached and these metals will be evaluated further in the baseline ecological risk assessment.

A limited number of SEVs are available for the pesticides measured at Northport by USGS. For those pesticides with an SEV, dieldrin could not be evaluated because its detection limit exceeded the SEV. None of the other pesticides had measured concentrations above their SEVs.

[7] The draft SLERA remains under review by EPA and to date has not been approved.

9 DATA GAPS

Current data regarding COI concentrations in surface water within the UCR study area are generally limited to locations near Northport. More widespread surface water sampling is recommended to facilitate the characterization of exposures by ecological and human receptors. Spatially representative stations should be identified between Northport and Grand Coulee Dam. Given the nature of sources to the UCR, metal/metalloid COIs should be the primary focus of the surface water study, with organic COIs of secondary interest. Samples should be collected seasonally to reflect differences in river flows and pool levels.

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FIGURES

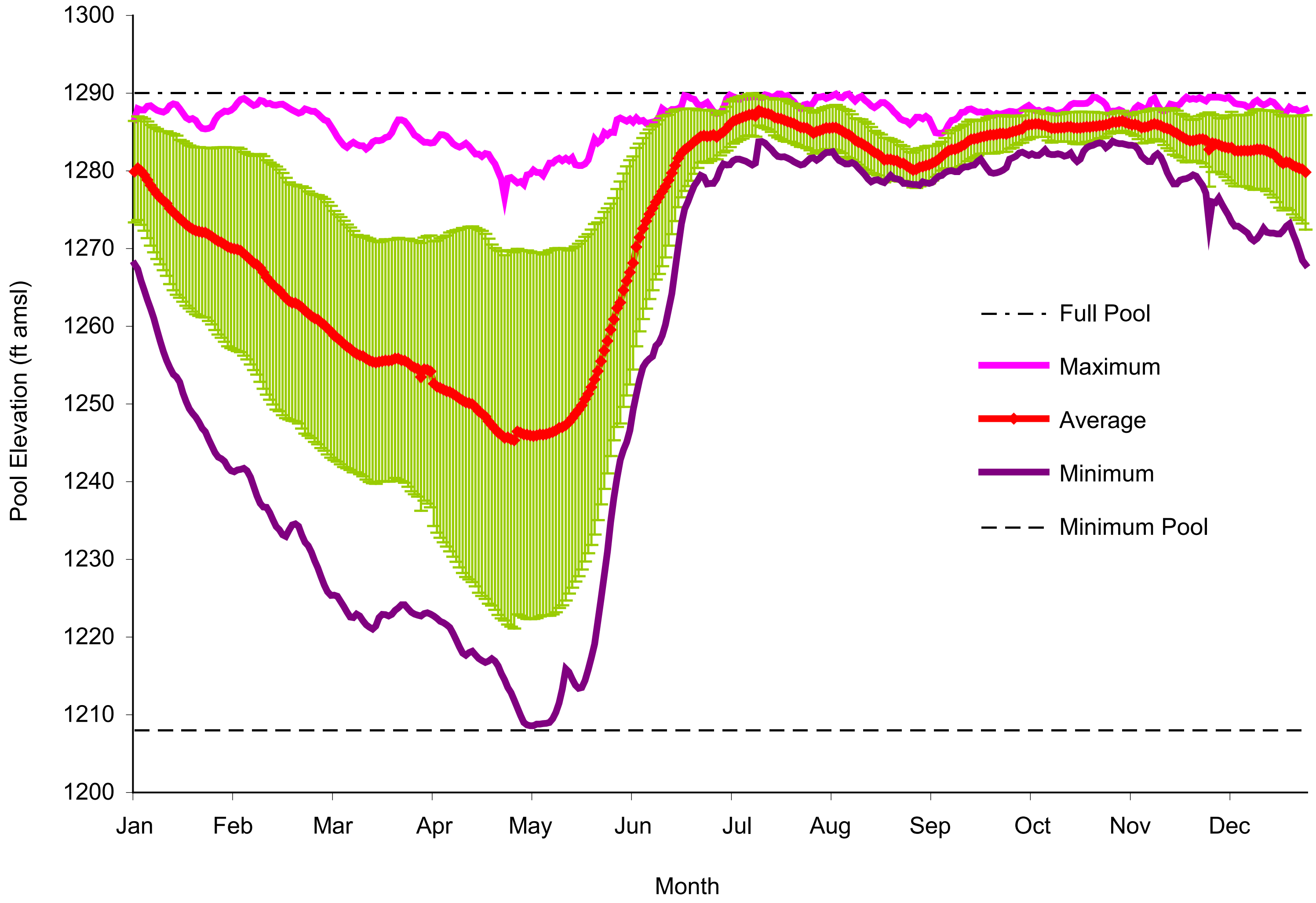


Figure 1. Daily Pool Elevations over the Period 1995–2005.
Source: http://www.cbr.washington.edu/dart/dart.html (September 2006).
Note: The shaded area around the average represents one standard deviation.

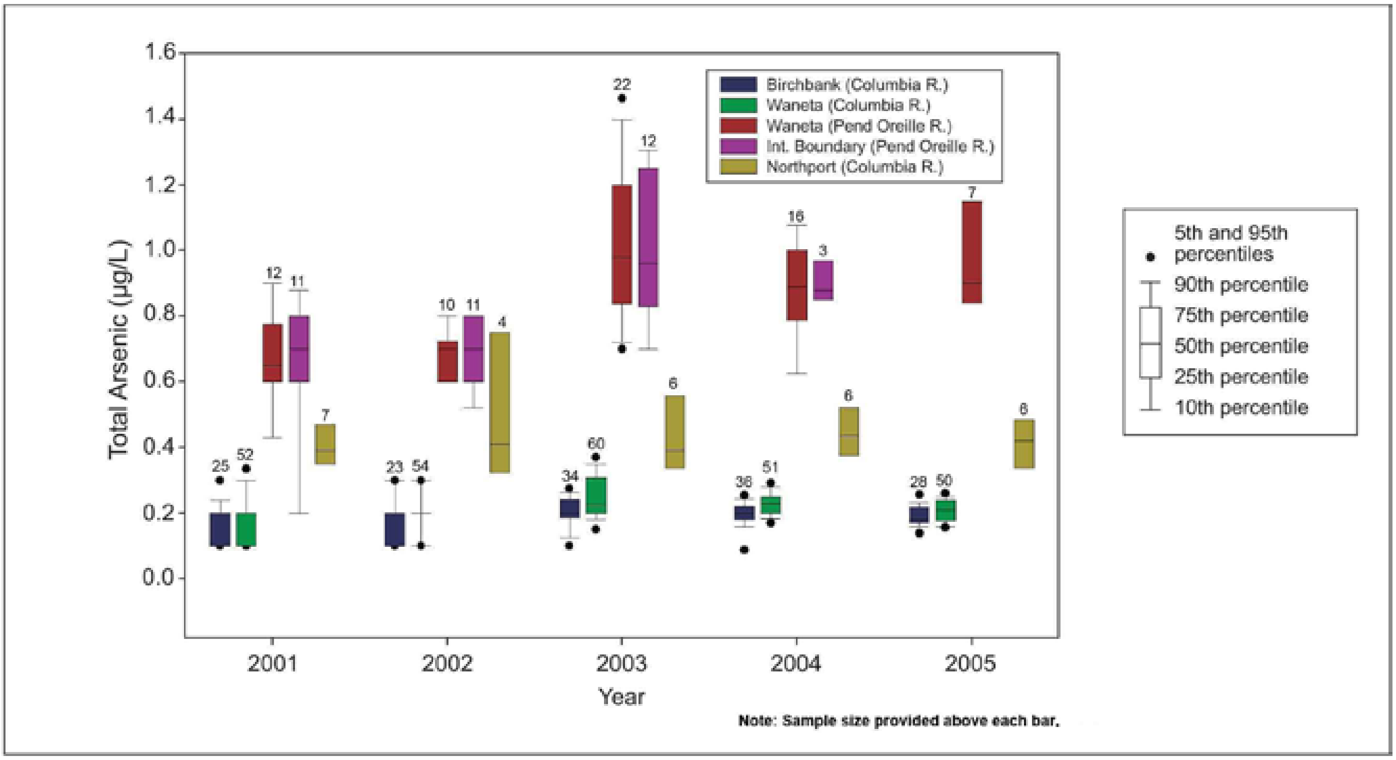


Figure 2. Total Arsenic: Comparison of Surface Water Concentrations at Birchbank, Waneta, International Boundary, and Northport (2001-2005).
Source: Environment Canada (http://waterquality.ec.gc.ca); USGS (http://waterdata.usgs.gov).
Note: Box plots based only on detected concentrations.

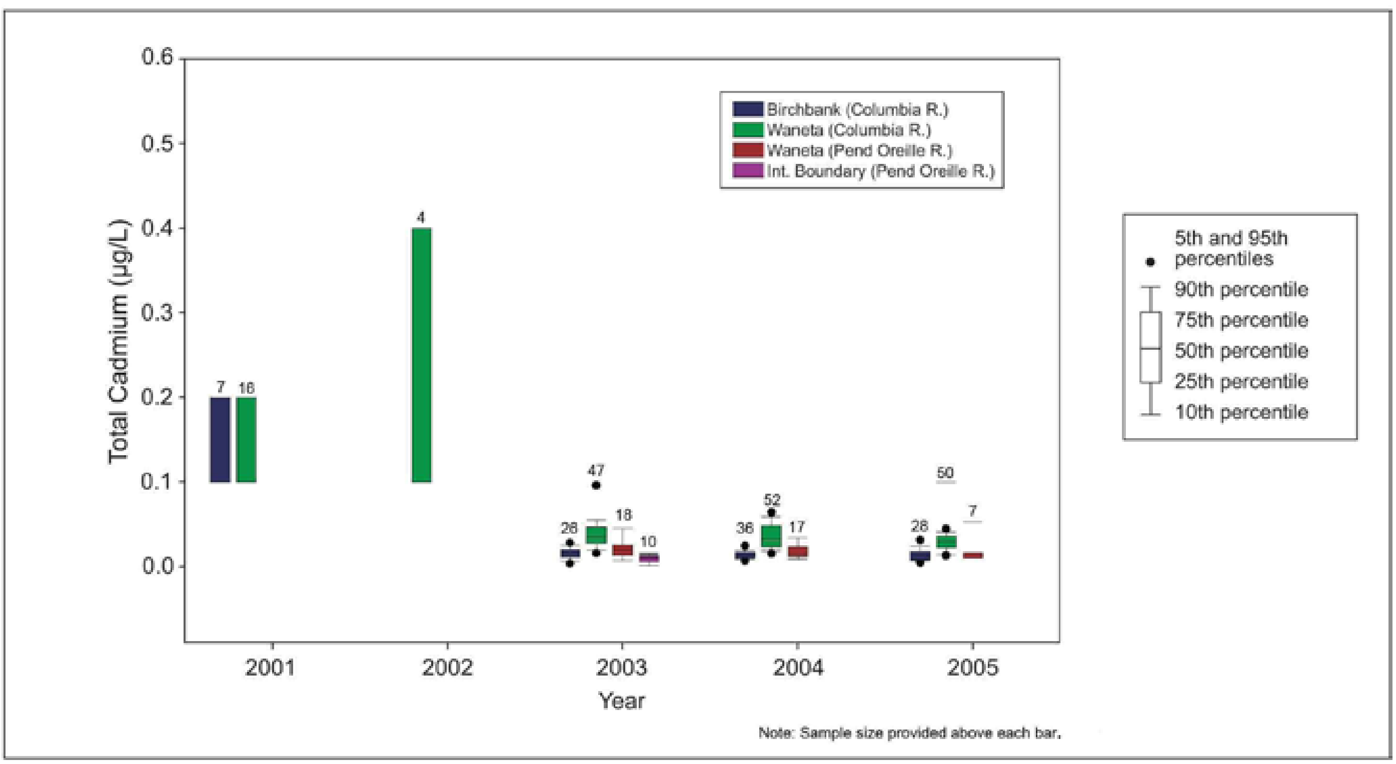


Figure 3. Total Cadmium: Comparison of Surface Water Concentrations at Birchbank, Waneta, and International Boundary (2001-2005).
Source: Environment Canada (http://waterquality.ec.gc.ca); USGS (http://waterdata.usgs.gov).
Note: Box plots based only on detected concentrations. Cadmium was detected in only 1 of 26 samples at Northport from 2001-2005 (detection limit of 0.1 µg/L). Data not available for Pend Oreille in 2001 and 2002.

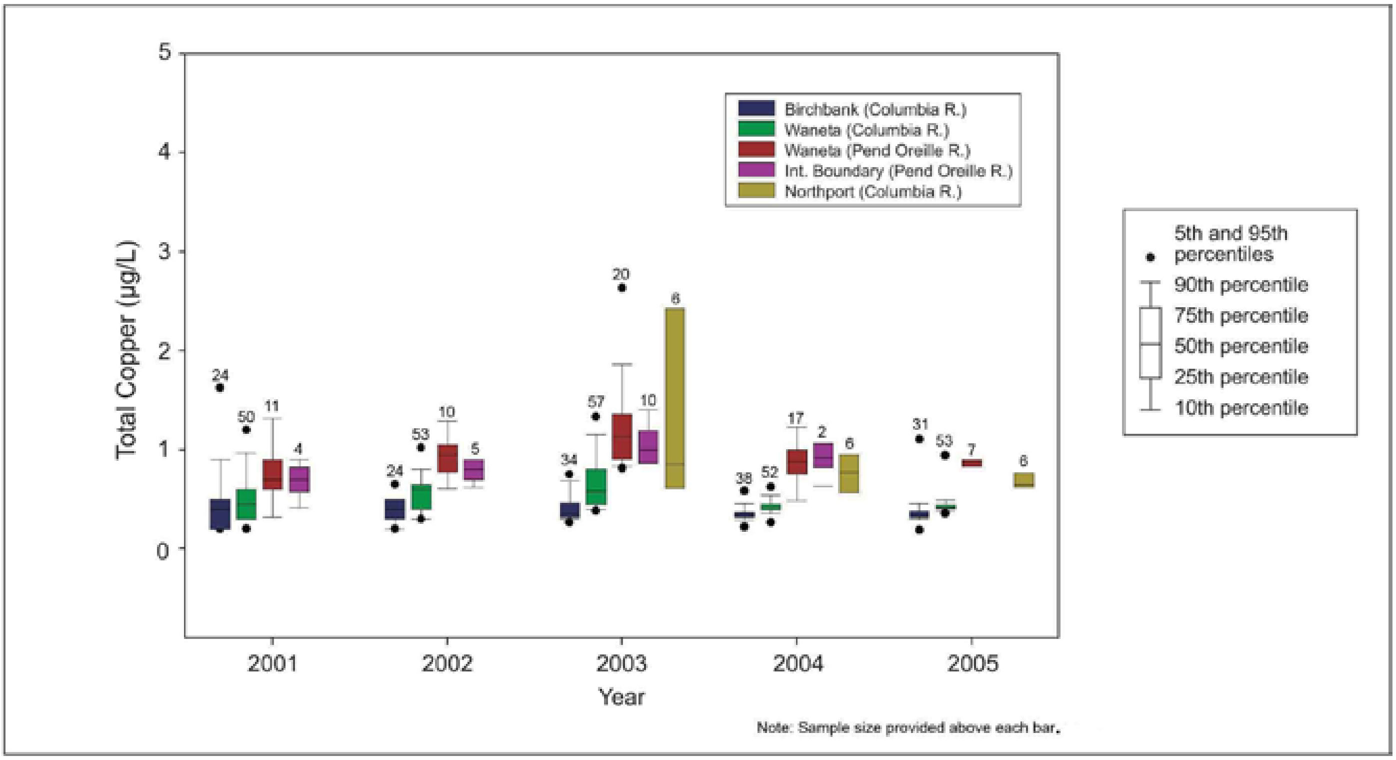


Figure 4. Total Copper: Comparison of Surface Water Concentrations at Birchbank, Waneta, International Boundary, and Northport (2001-2005).
Source: Environment Canada (http://waterquality.ec.gc.ca); USGS (http://waterdata.usgs.gov).
Note: Box plots based only on detected concentrations. Copper was not detected at Northport in 2001 and only twice in 2002 (0.49 and 0.78 µg/L).

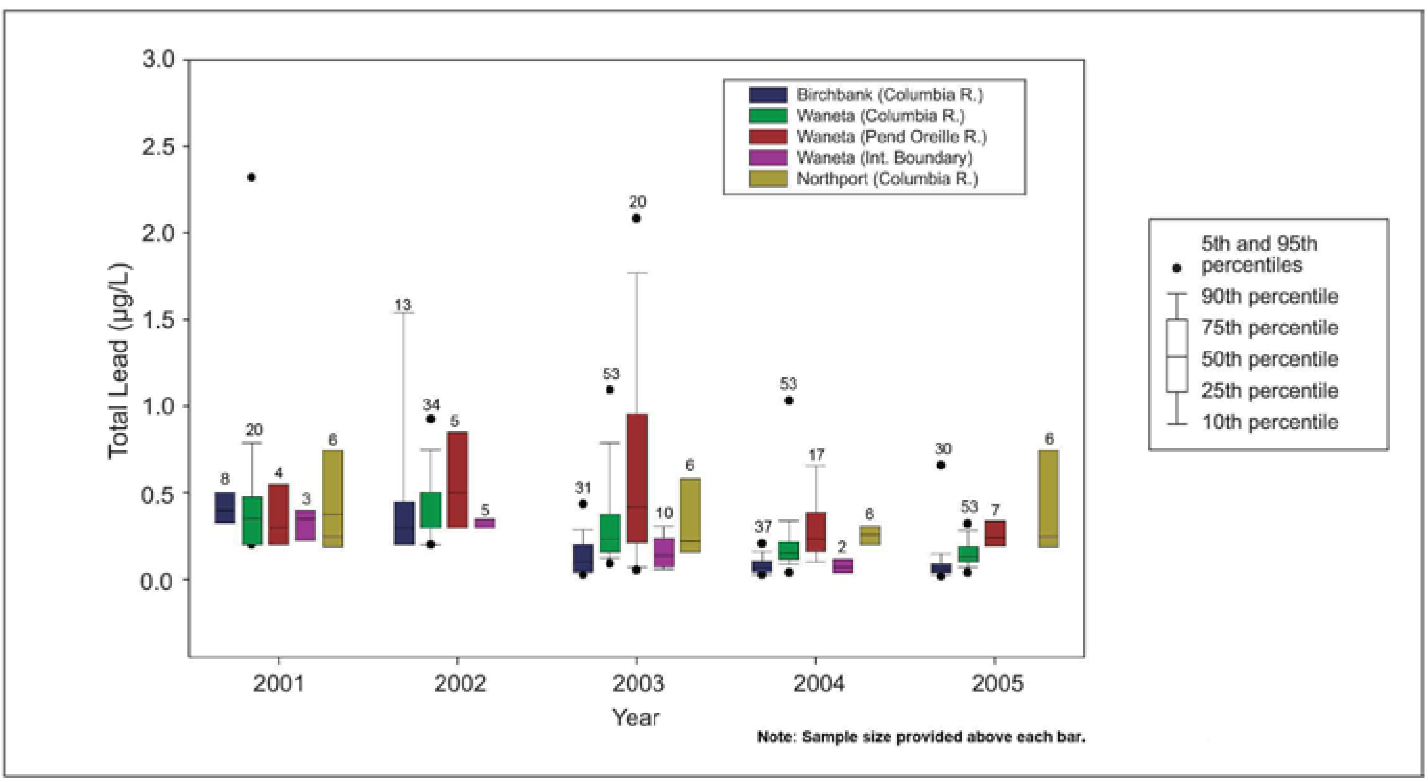


Figure 5. Total Lead: Comparison of Surface Water Concentrations at Birchbank, Waneta, International Boundary, and Northport (2001-2005).
Source: Environment Canada (http://waterquality.ec.gc.ca); USGS (http://waterdata.usgs.gov).
Note: Box plots based only on detected concentrations.

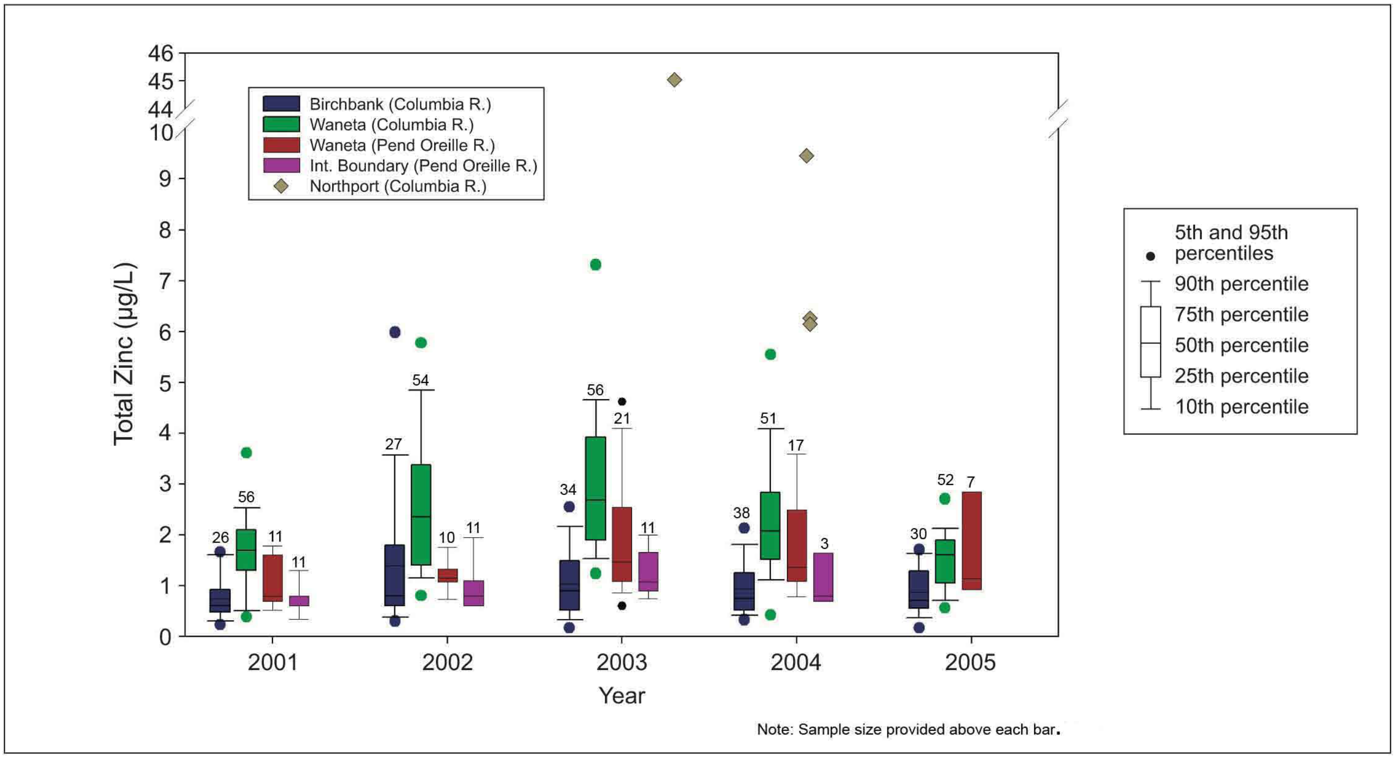


Figure 6. Total Zinc: Comparison of Surface Water Concentrations at Birchbank, Waneta, International Boundary, and Northport (2001-2005).
Source: Environment Canada (http://waterquality.ec.gc.ca); USGS (http://waterdata.usgs.gov).
Note: Zinc was infrequently detected at Northport at a detection limit of 5 µg/L. Northport data (detected concentrations only) are shown as individual points. Box plots based only on detected concentrations.

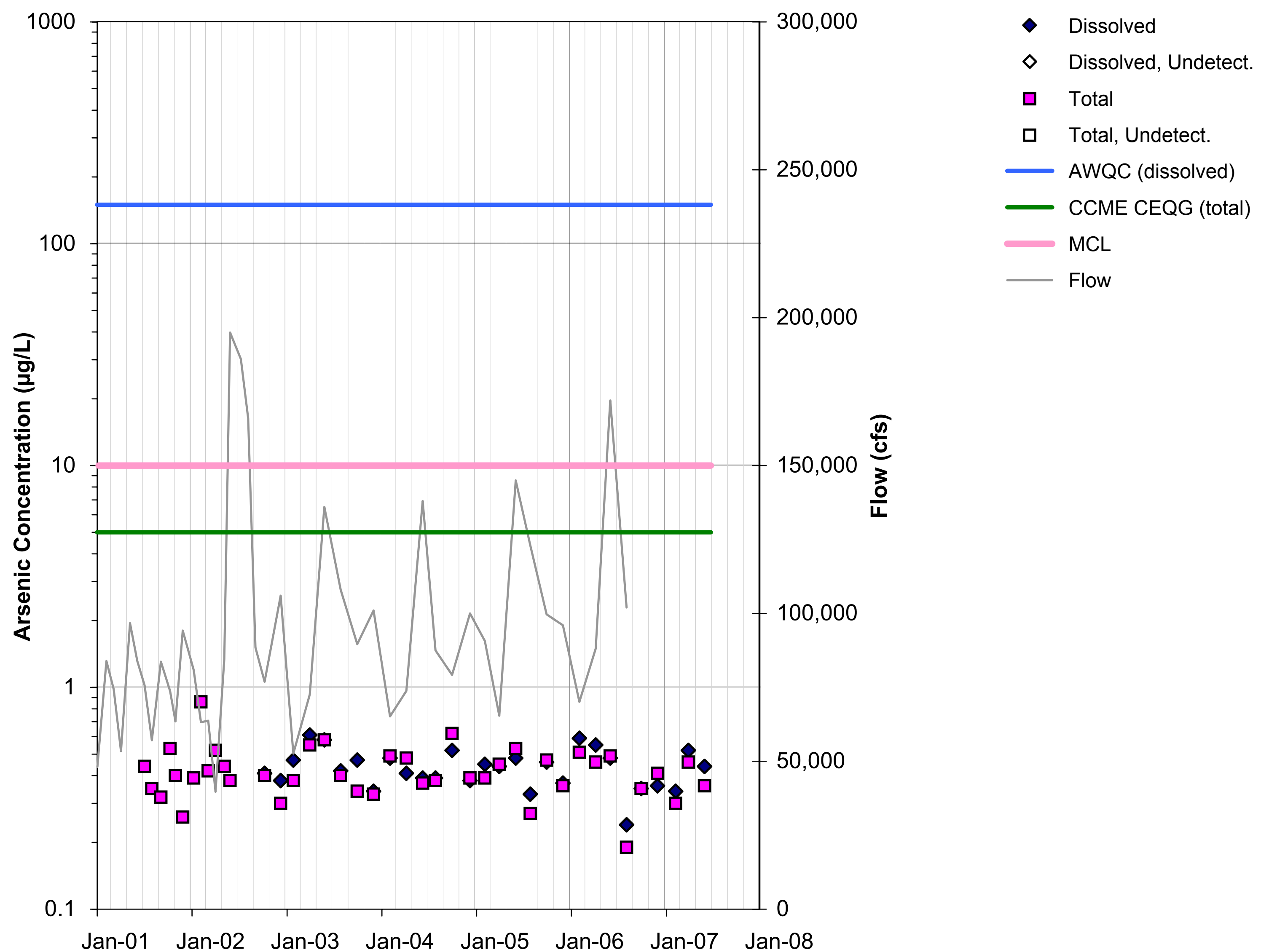


Figure 7. Dissolved and Total Recoverable Arsenic Concentrations in Surface Water Samples Collected at Northport (2001–2007).

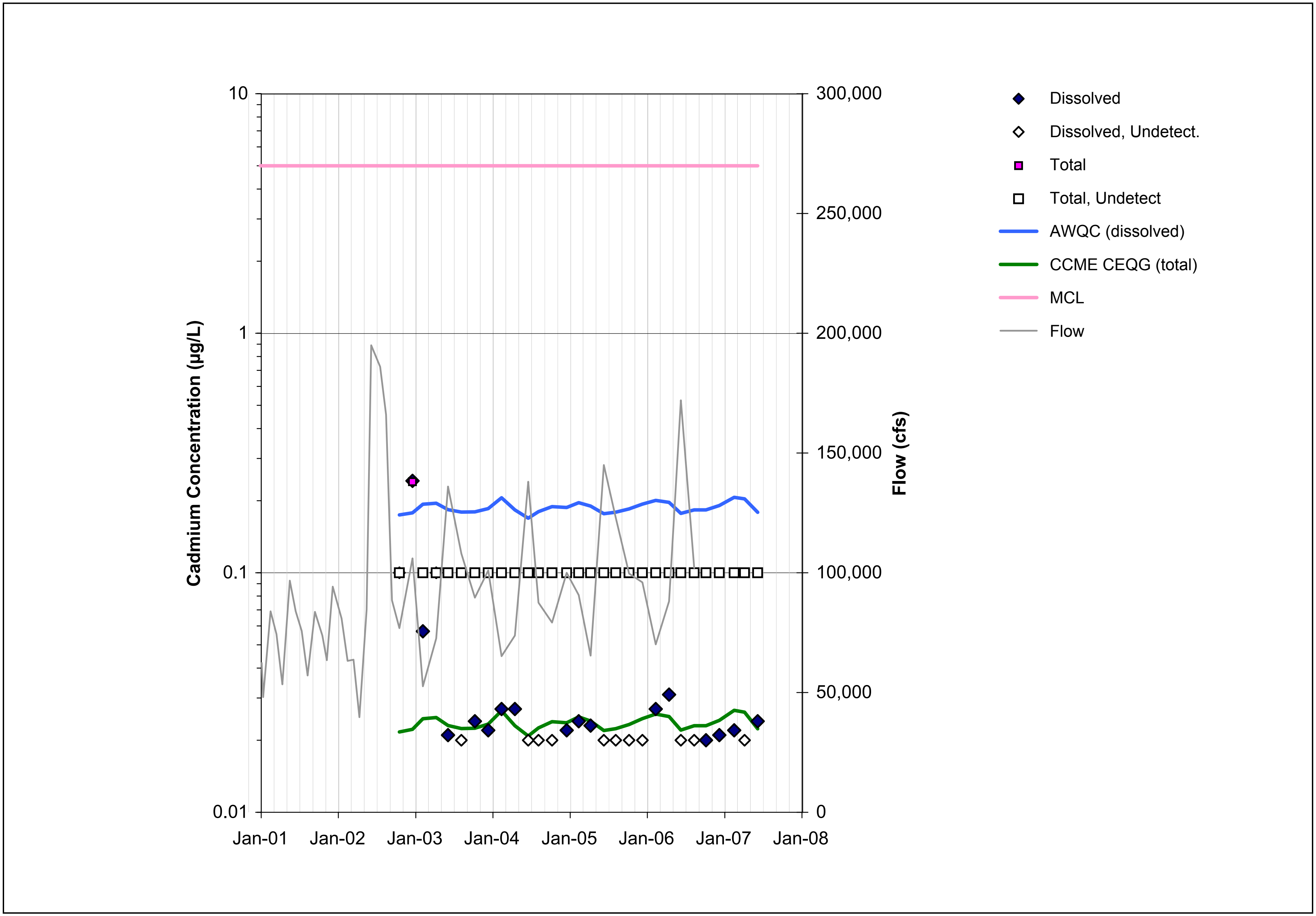


Figure 8. Dissolved and Total Recoverable Cadmium Concentrations in Surface Water Samples Collected at Northport (2001–2007).

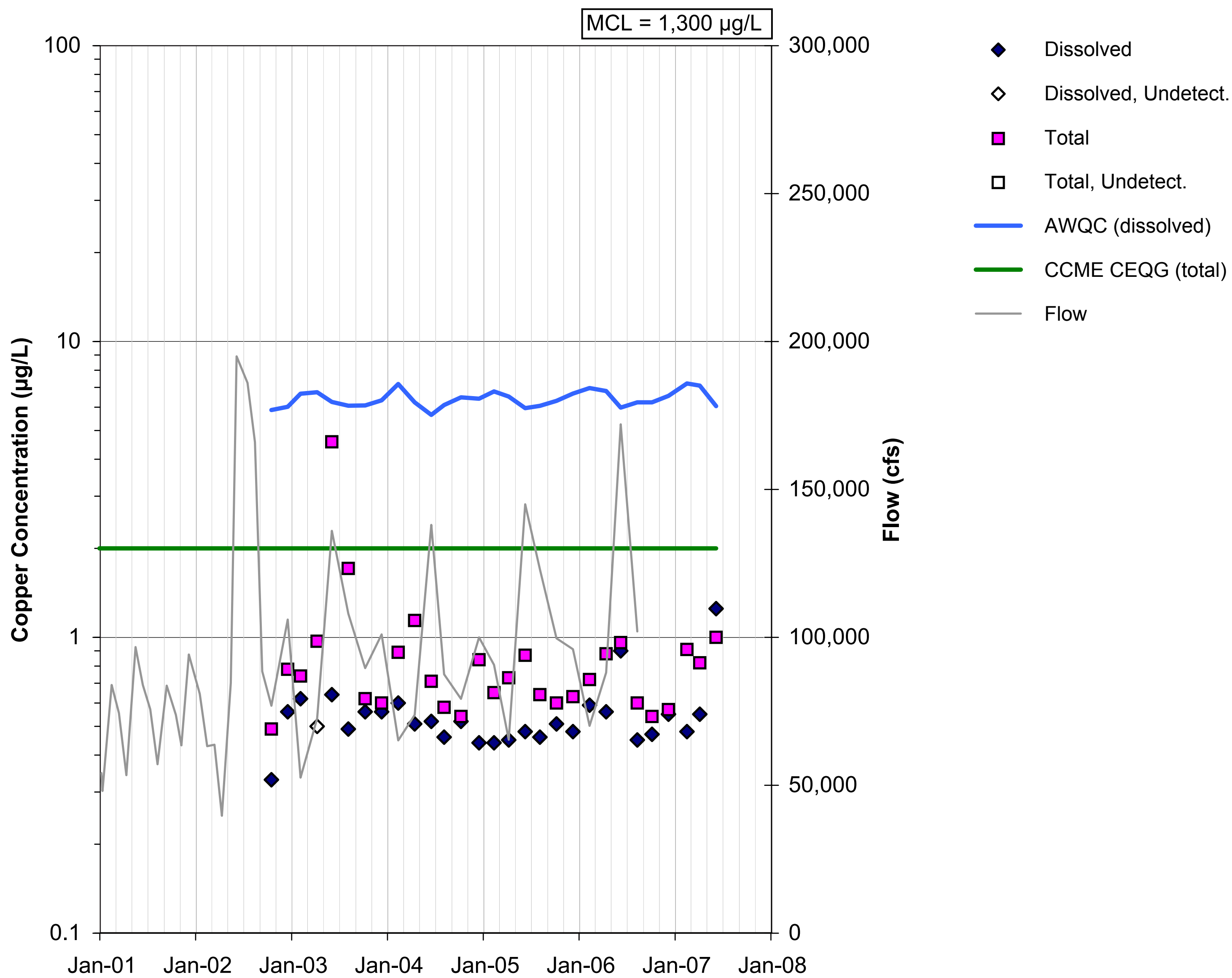


Figure 9. Dissolved and Total Recoverable Copper Concentrations in Surface Water Samples Collected at Northport (2001–2007).

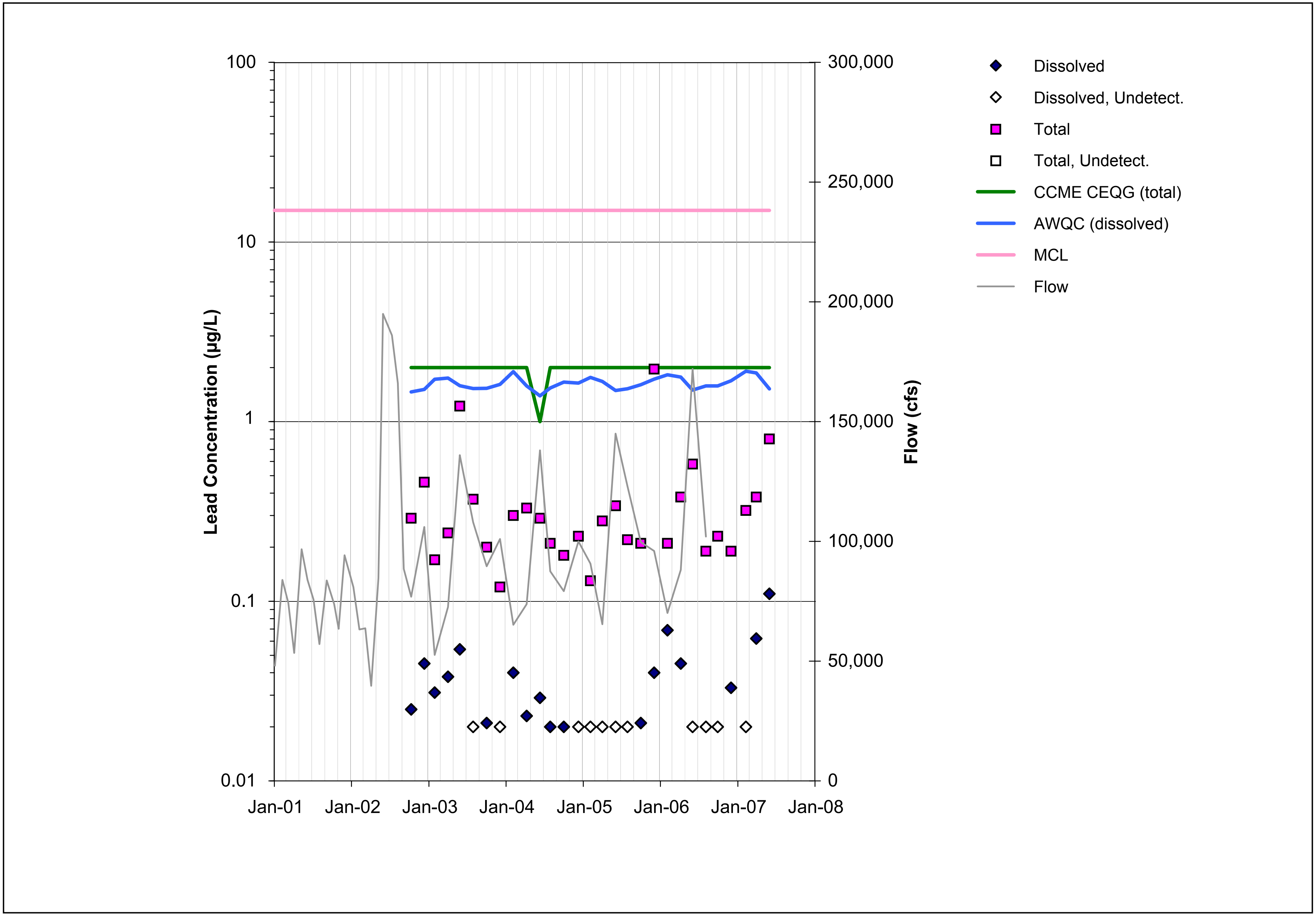


Figure 10. Dissolved and Total Recoverable Lead Concentrations in Surface Water Samples Collected at Northport (2001–2007).

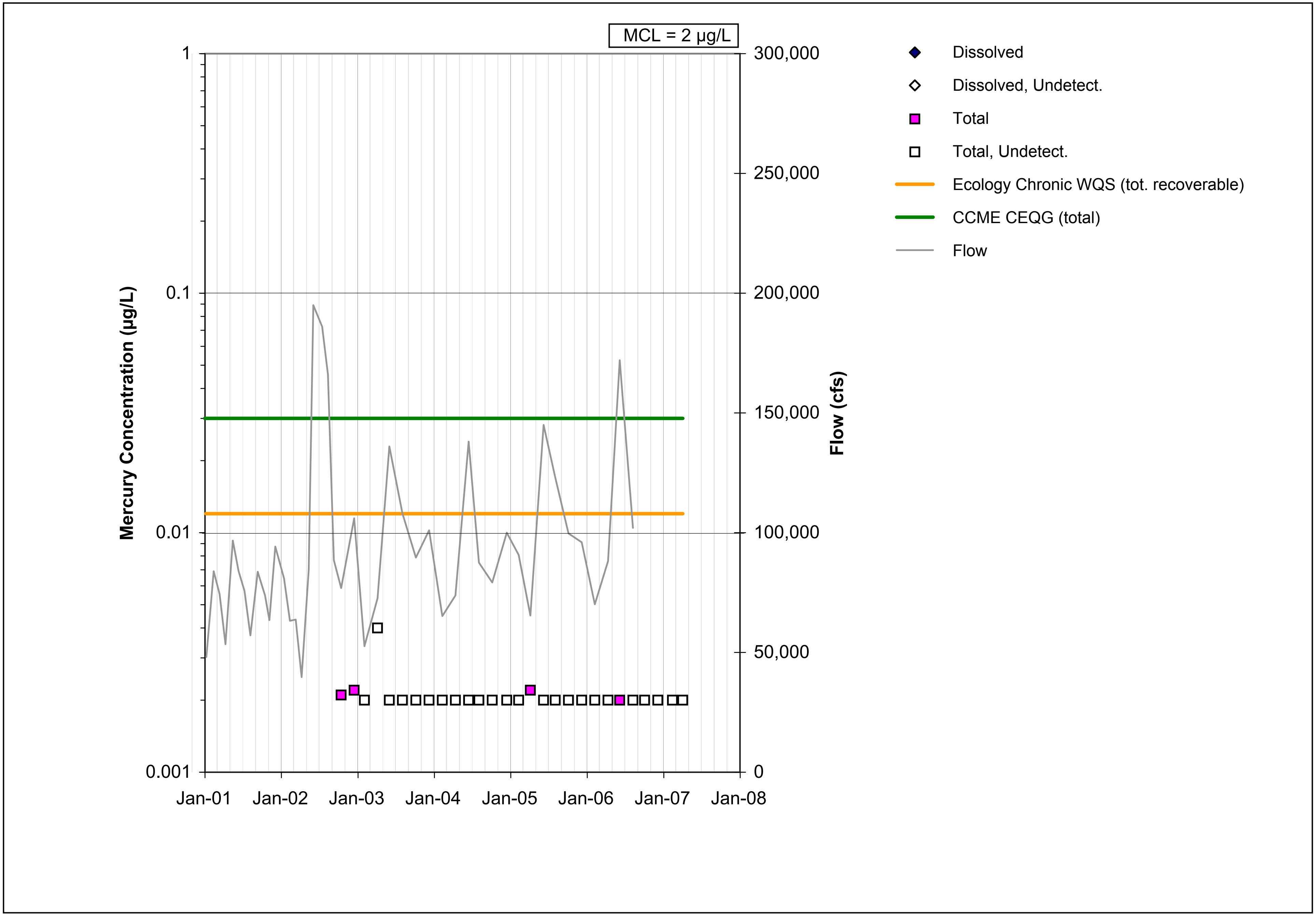


Figure 11. Dissolved and Total Recoverable Mercury Concentrations in Surface Water Samples Collected at Northport (2001–2007).

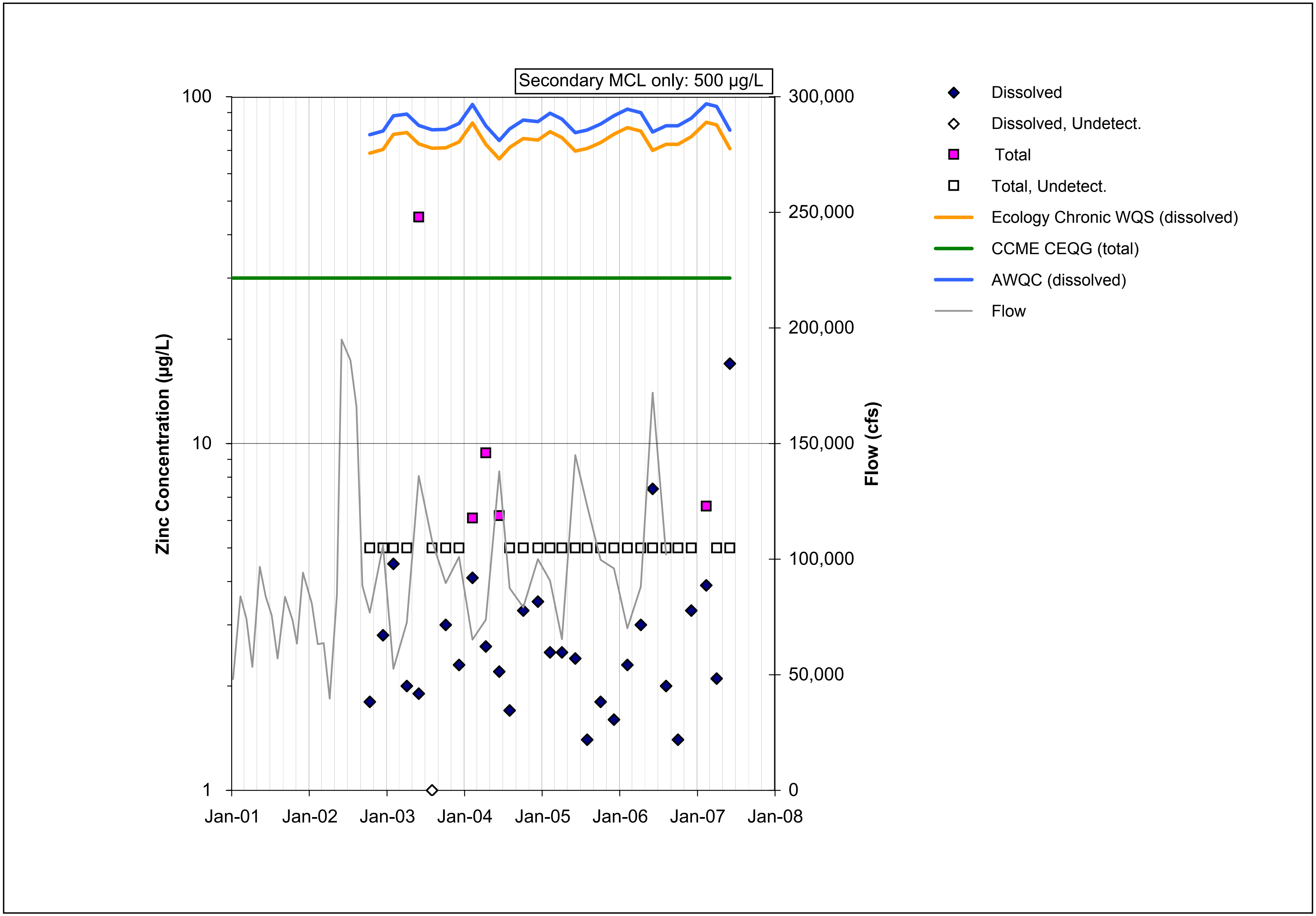


Figure 12. Dissolved and Total Recoverable Zinc Concentrations in Surface Water Samples Collected at Northport (2001–2007).

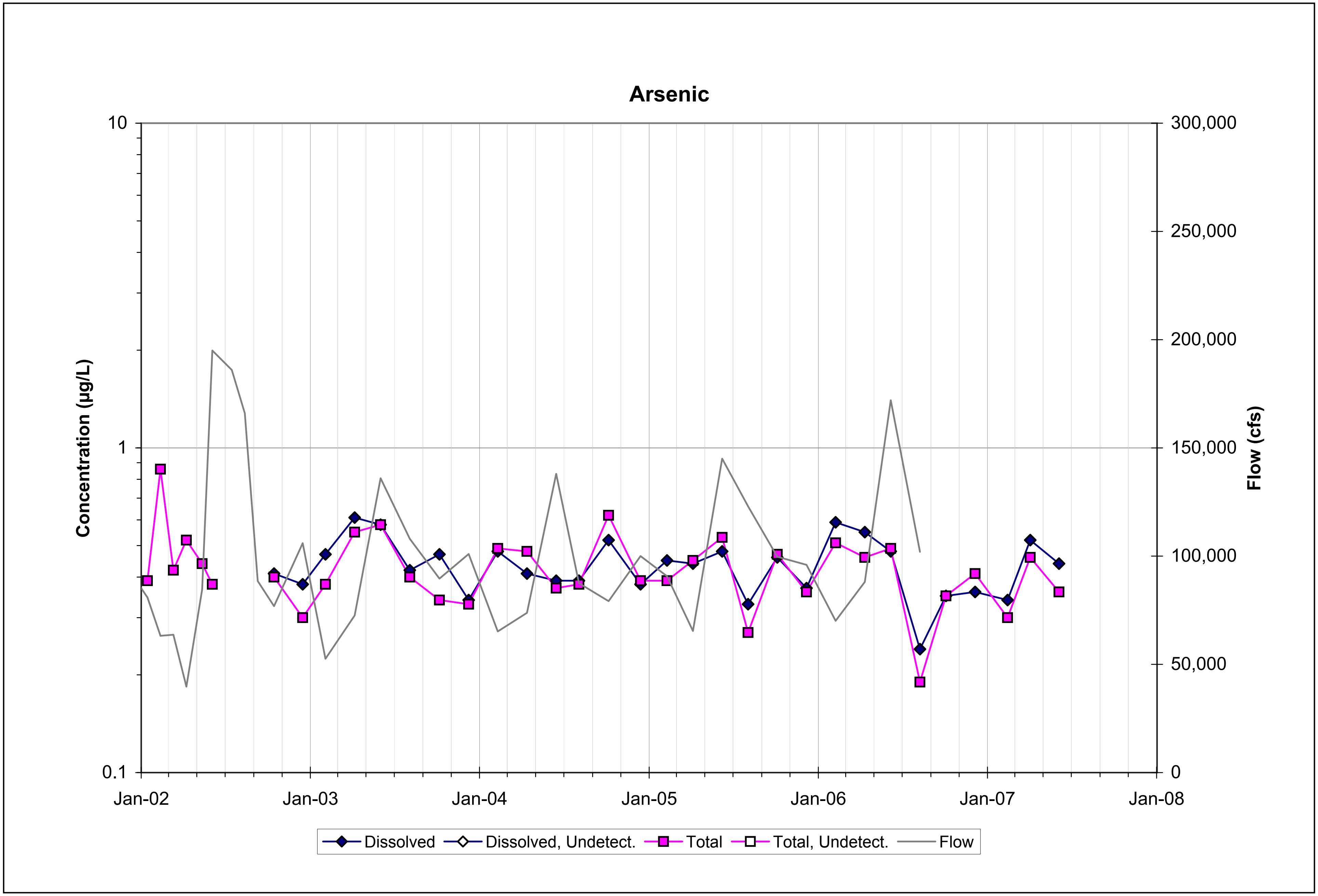


Figure 13. Dissolved and Total Recoverable Arsenic Concentrations in Surface Water Samples Collected at Northport (2002–2007).

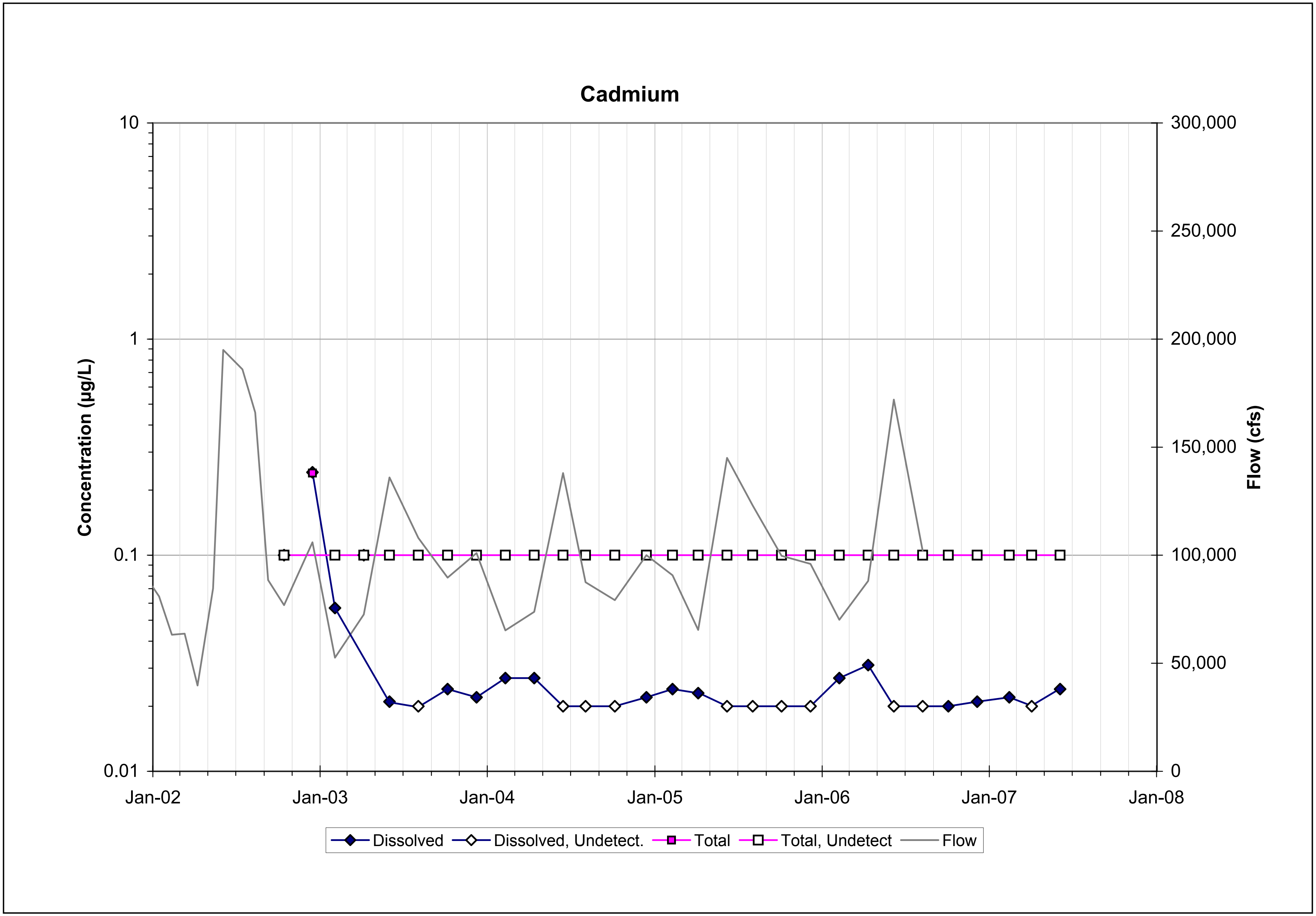


Figure 14. Dissolved and Total Recoverable Cadmium Concentrations in Surface Water Samples Collected at Northport (2002–2007).

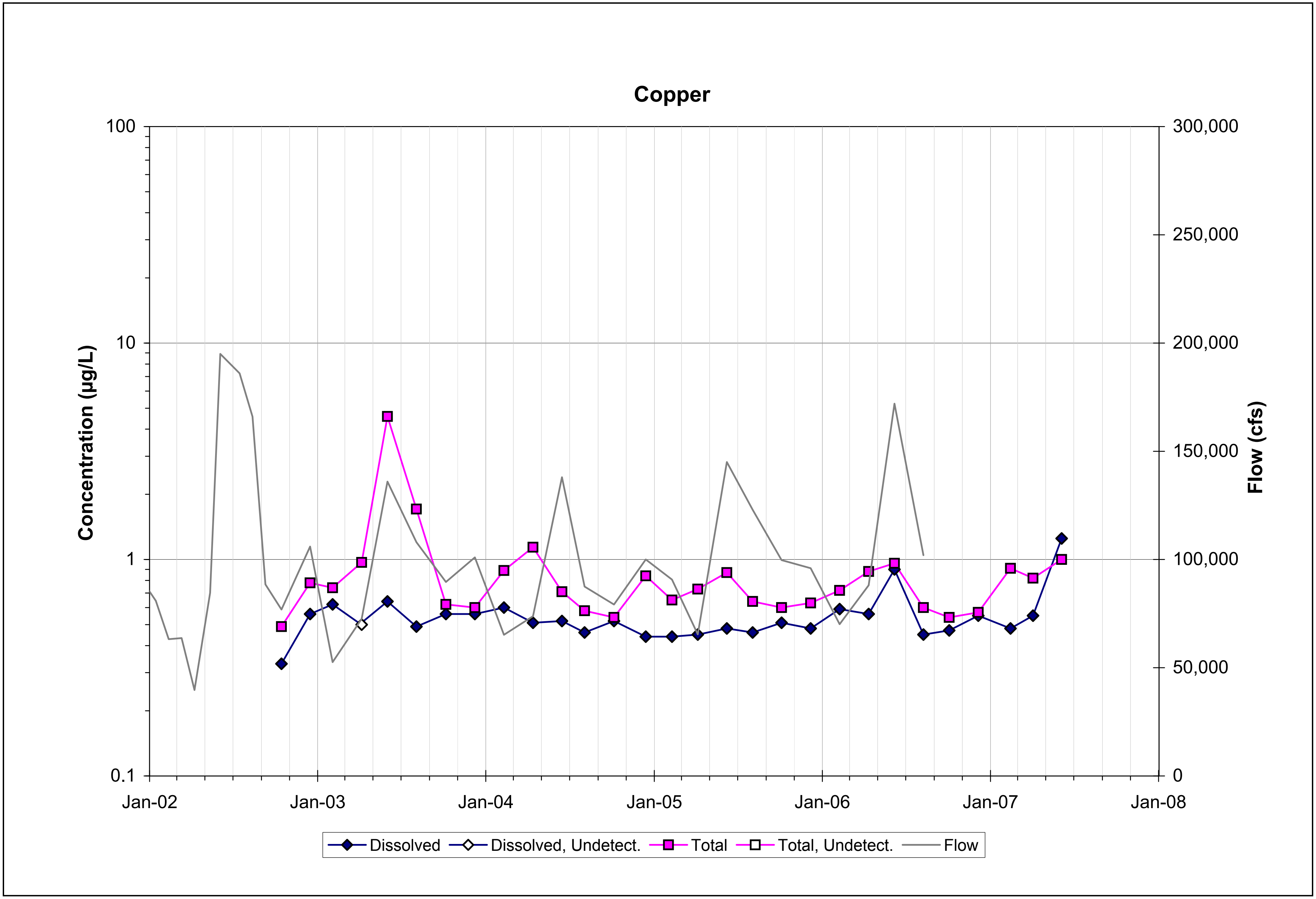


Figure 15. Dissolved and Total Recoverable Copper Concentrations in Surface Water Samples Collected at Northport (2002–2007).

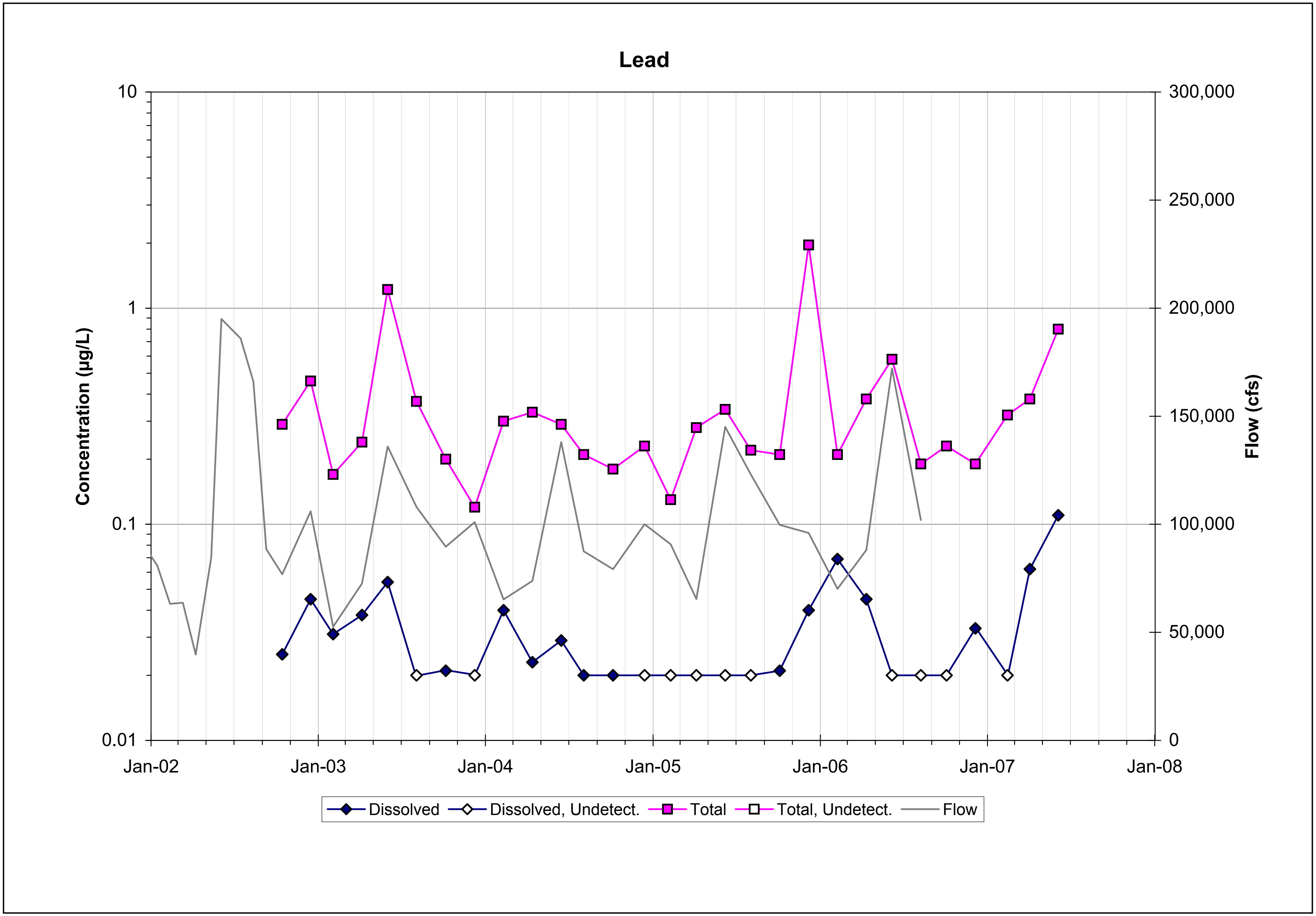


Figure 16. Dissolved and Total Recoverable Lead Concentrations in Surface Water Samples Collected at Northport (2002–2007).

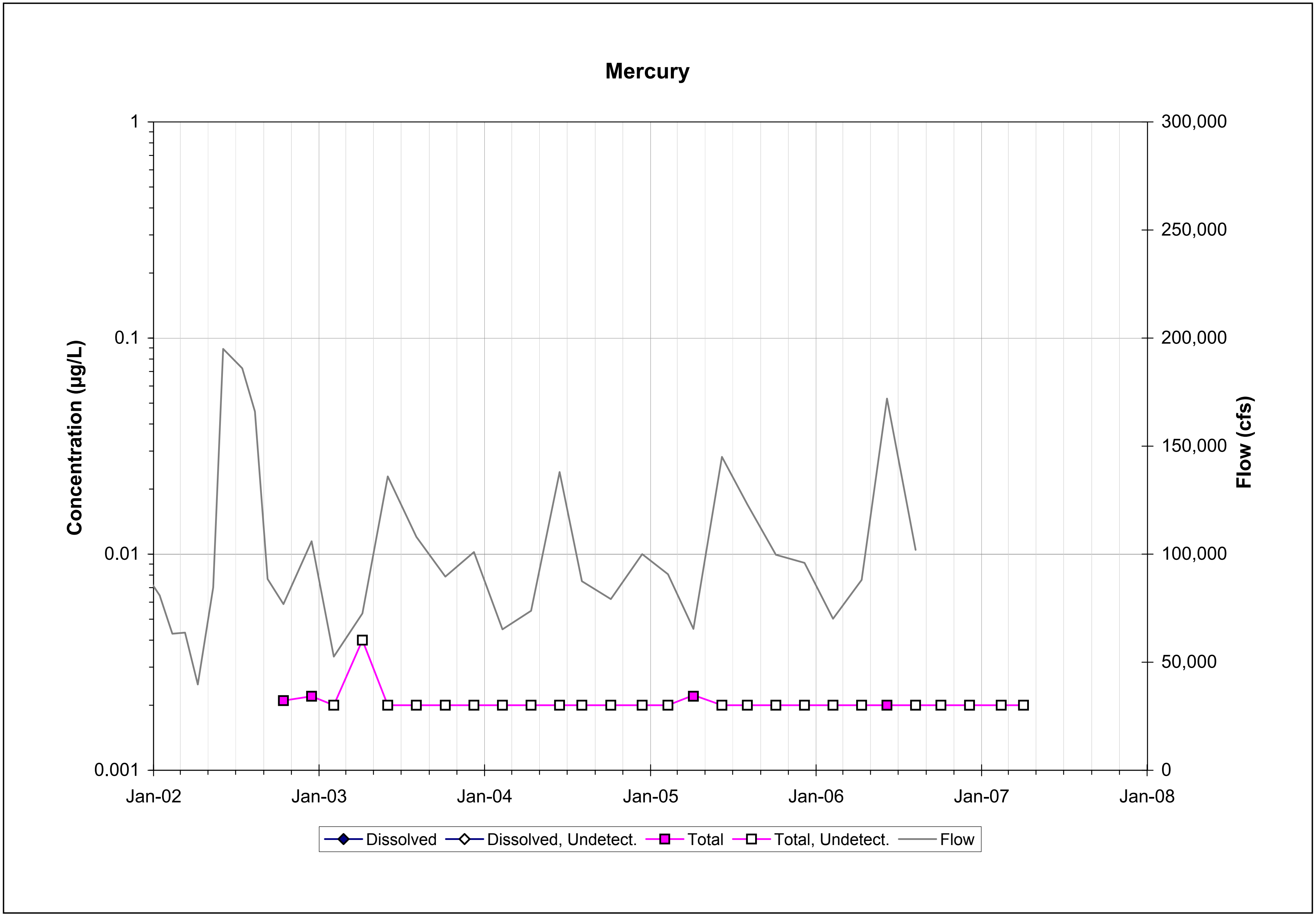


Figure 17. Dissolved and Total Recoverable Mercury Concentrations in Surface Water Samples Collected at Northport (2002–2007).

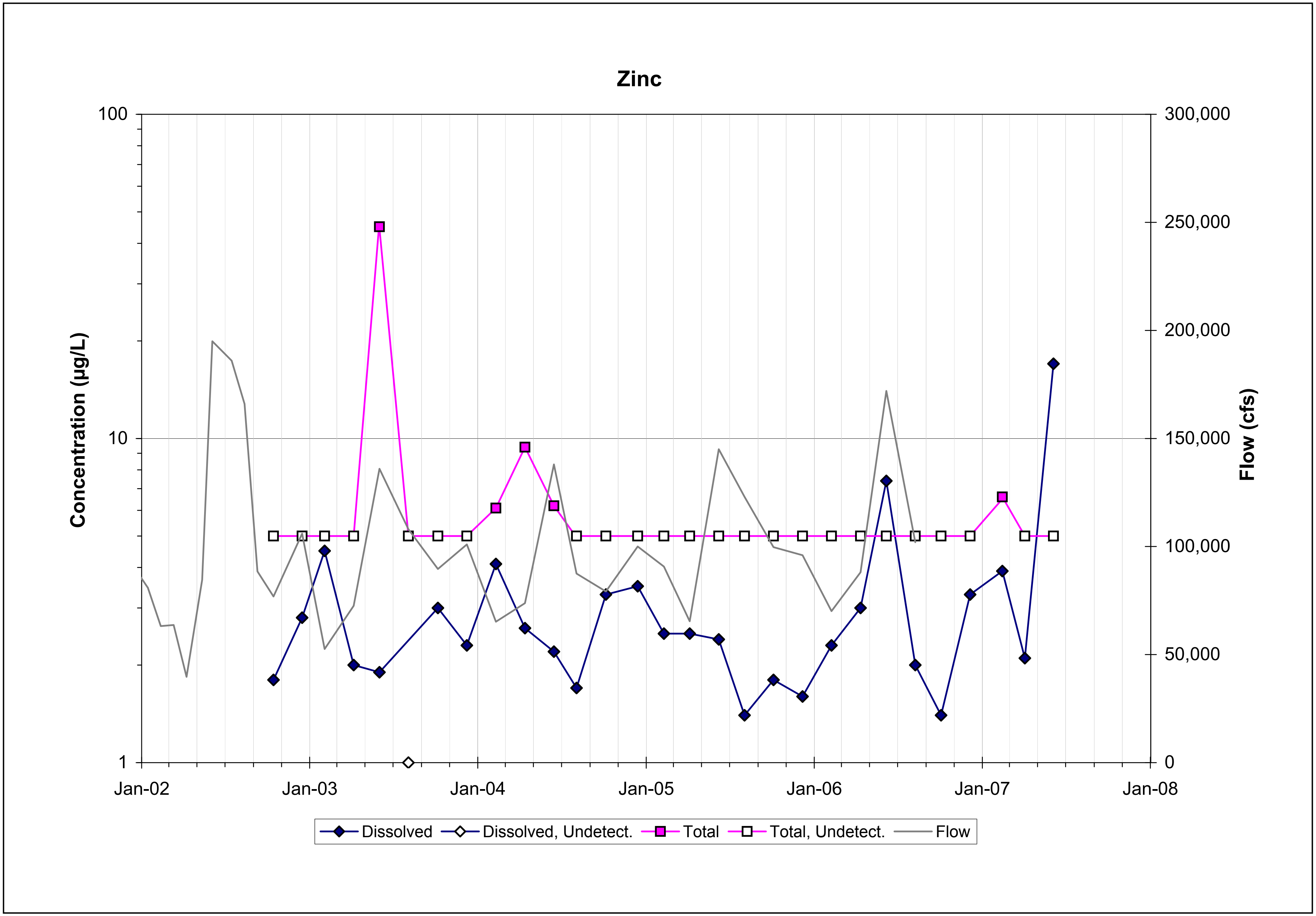


Figure 18. Dissolved and Total Recoverable Zinc Concentrations in Surface Water Samples Collected at Northport (2002–2007).

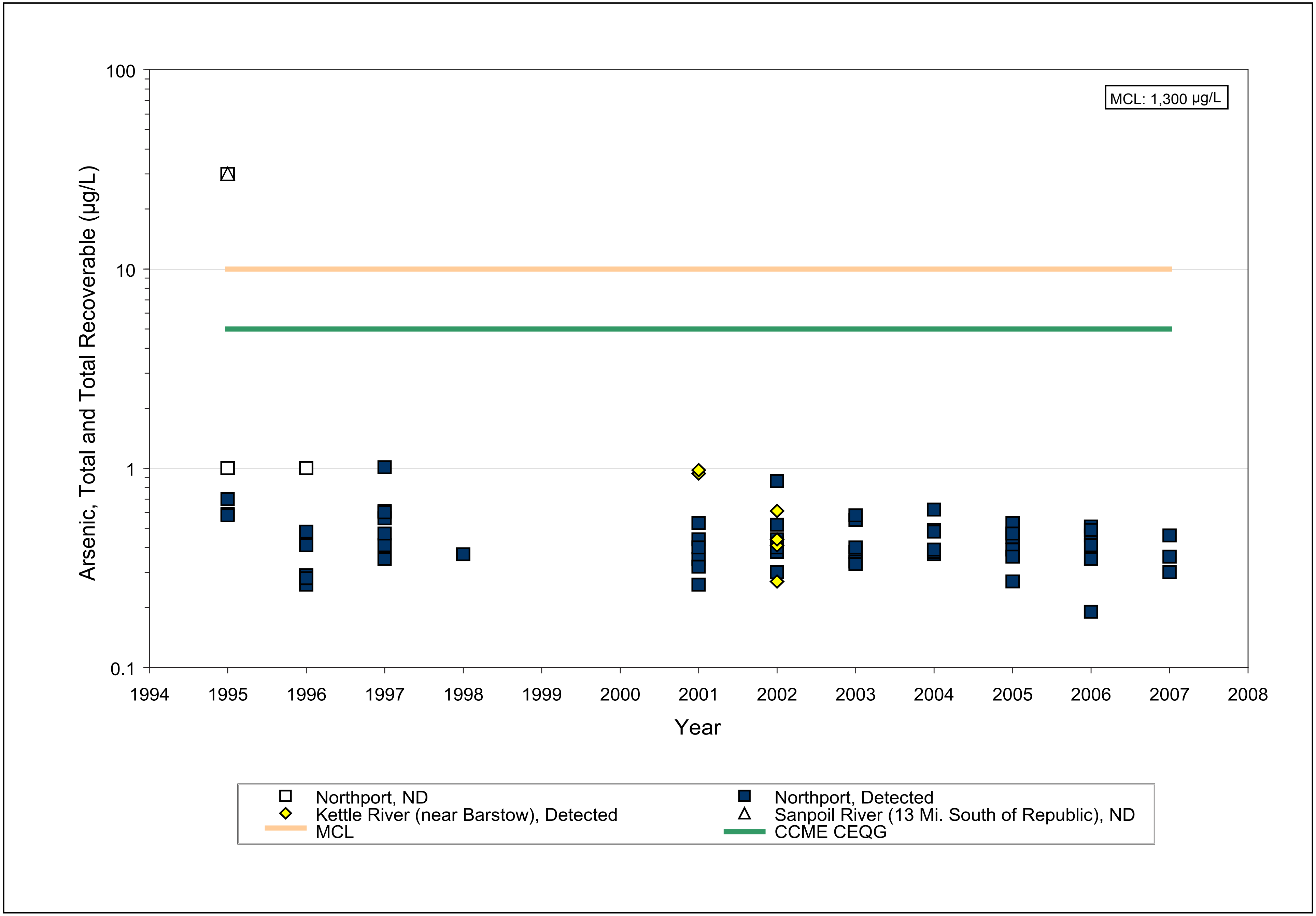


Figure 19. Available Total and Total Recoverable Arsenic Concentrations, Northport and Major Tributaries (1995–2007).

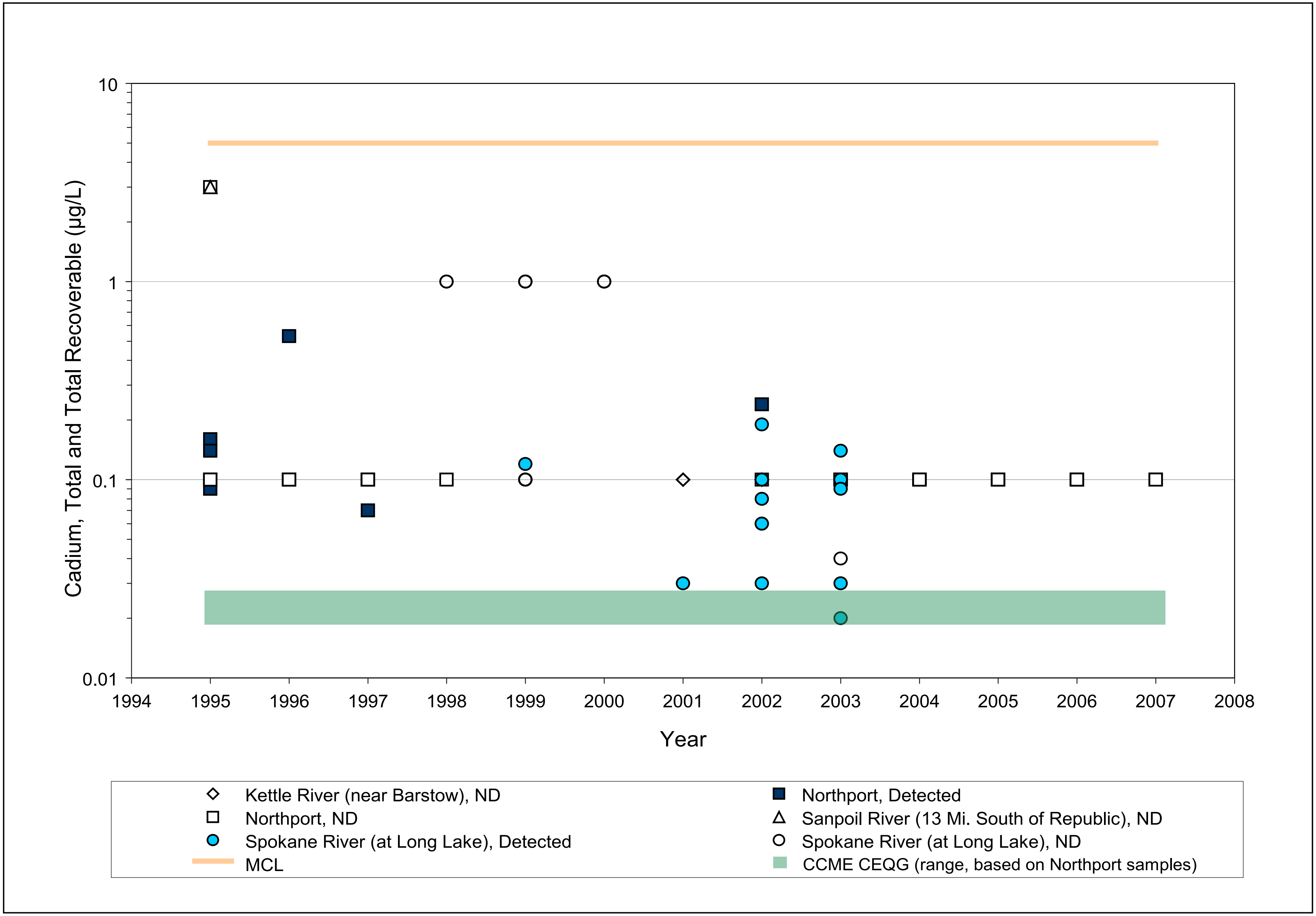


Figure 20. Available Total and Total Recoverable Cadmium Concentrations, Northport and Major Tributaries (1995–2007).

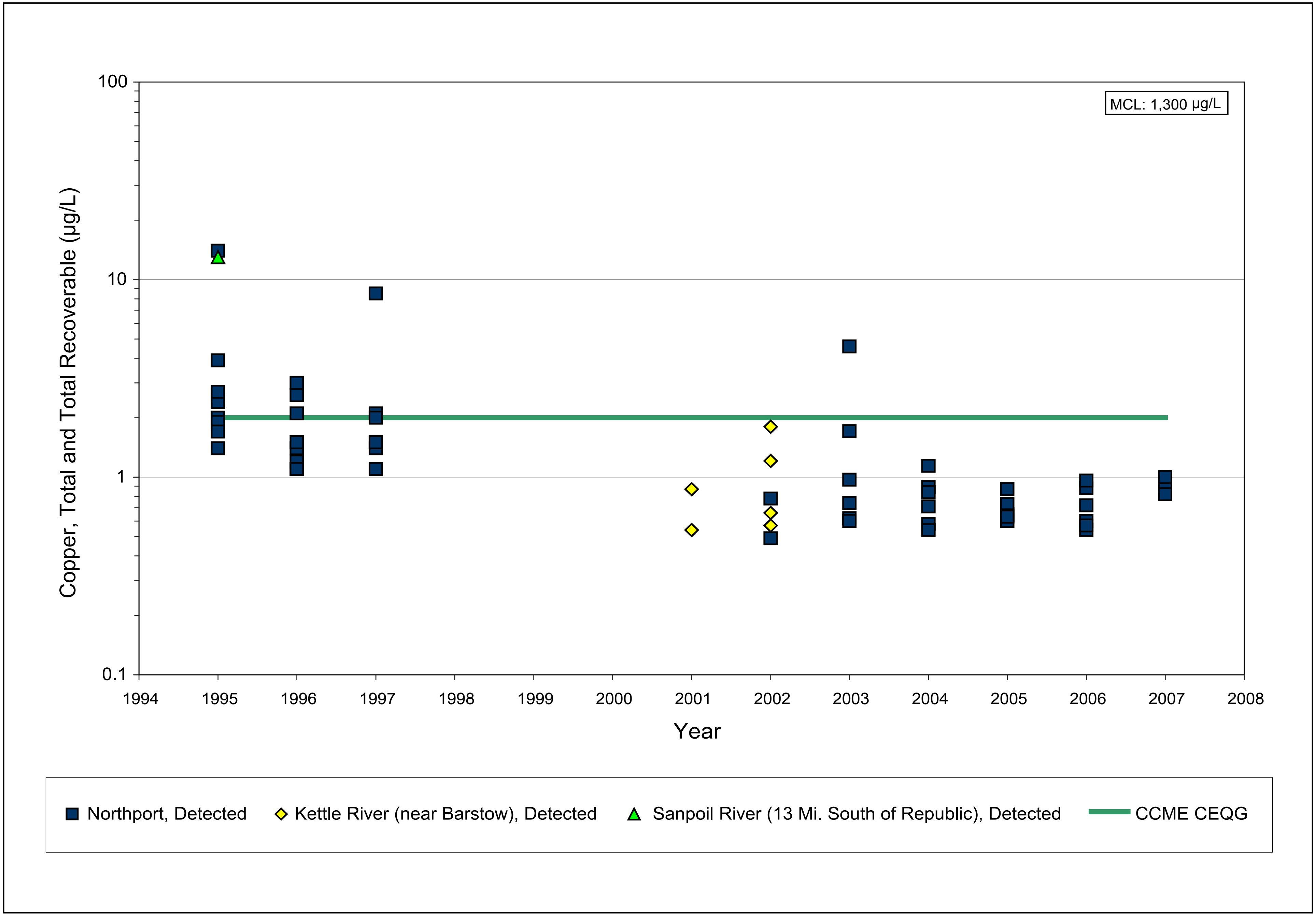


Figure 21. Available Total and Total Recoverable Copper Concentrations, Northport and Major Tributaries (1995–2007).

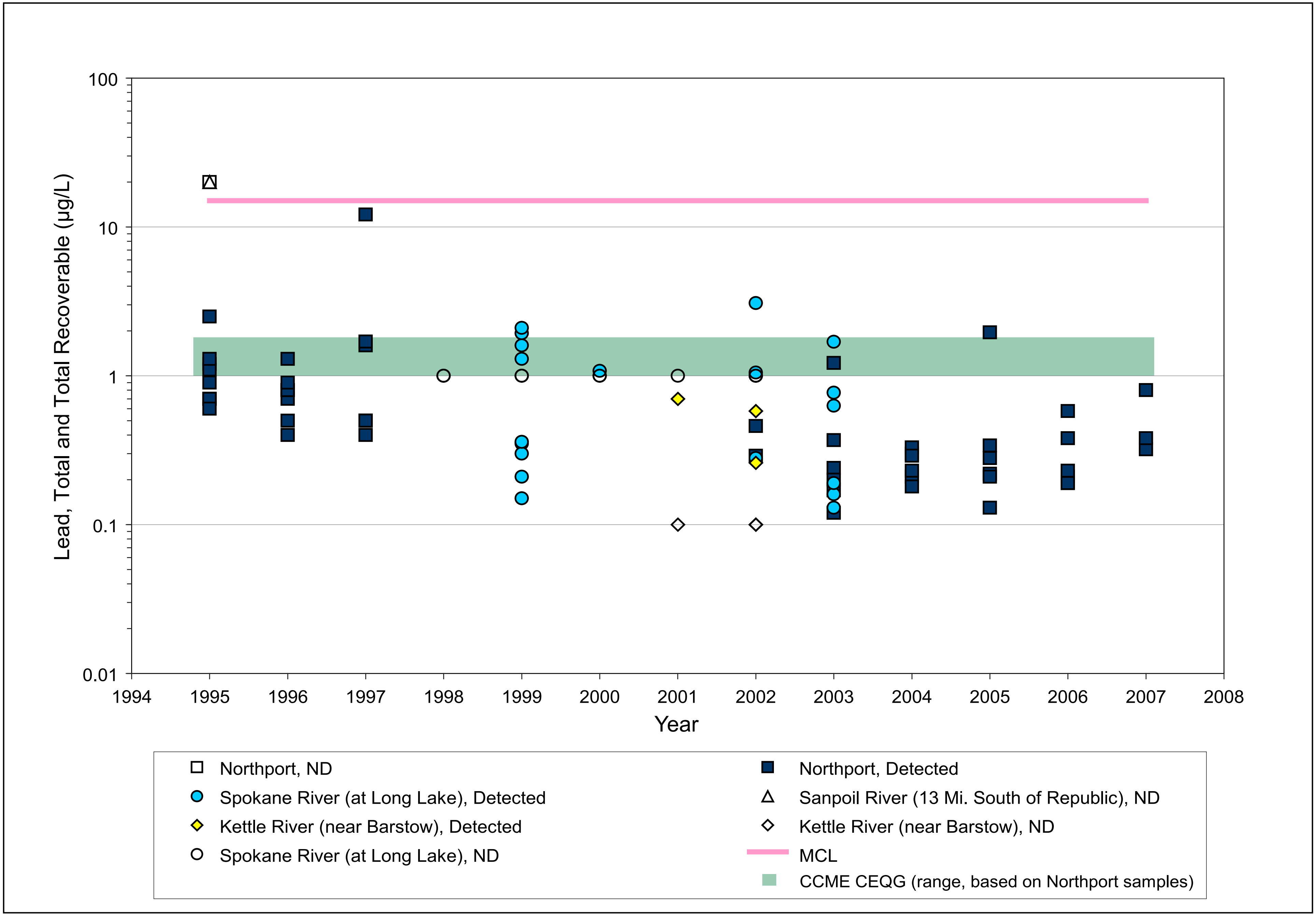


Figure 22. Available Total and Total Recoverable Lead Concentrations, Northport and Major Tributaries (1995–2007).

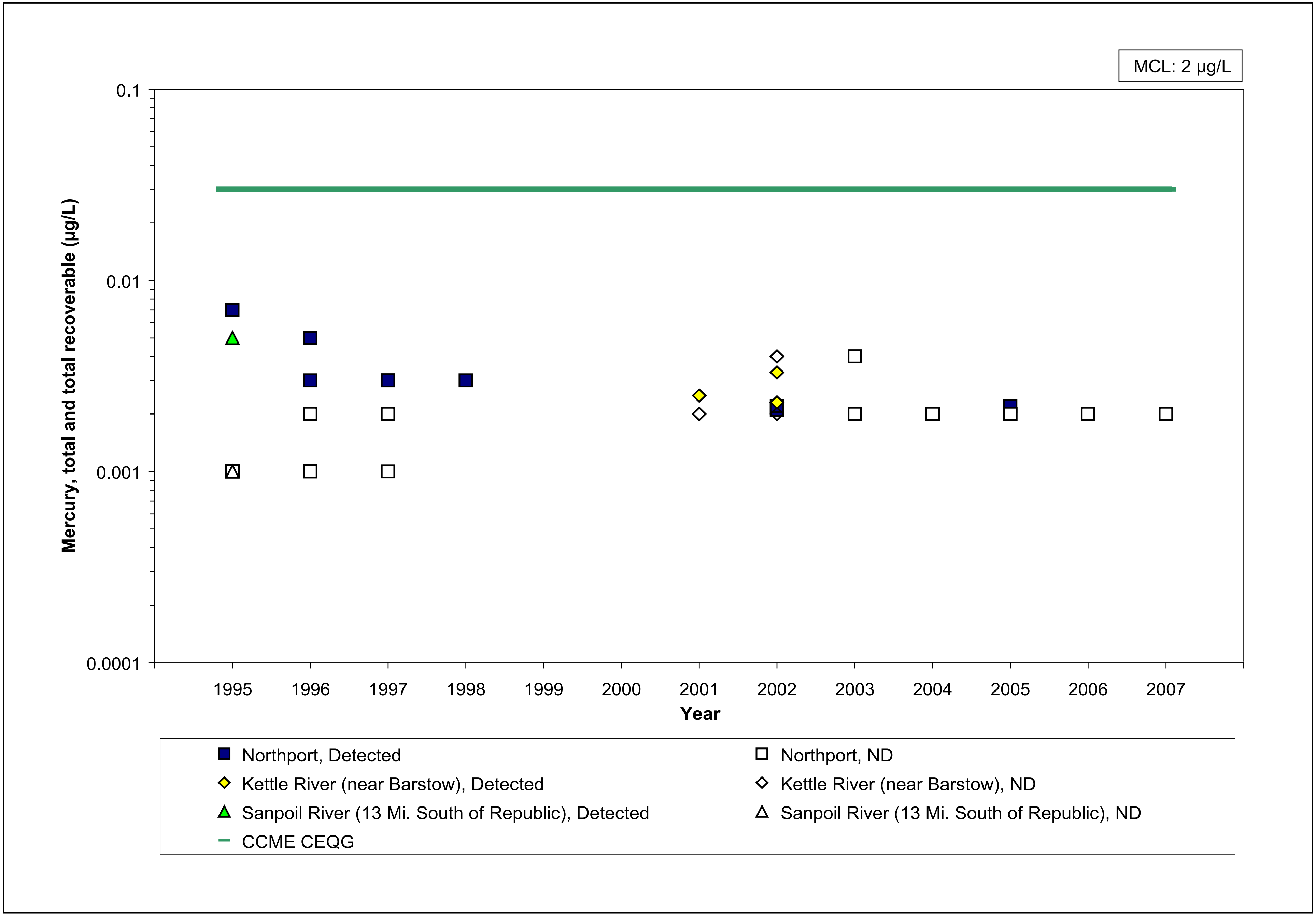


Figure 23. Available Total and Total Recoverable Mercury Concentrations, Northport and Major Tributaries (1995–2007).

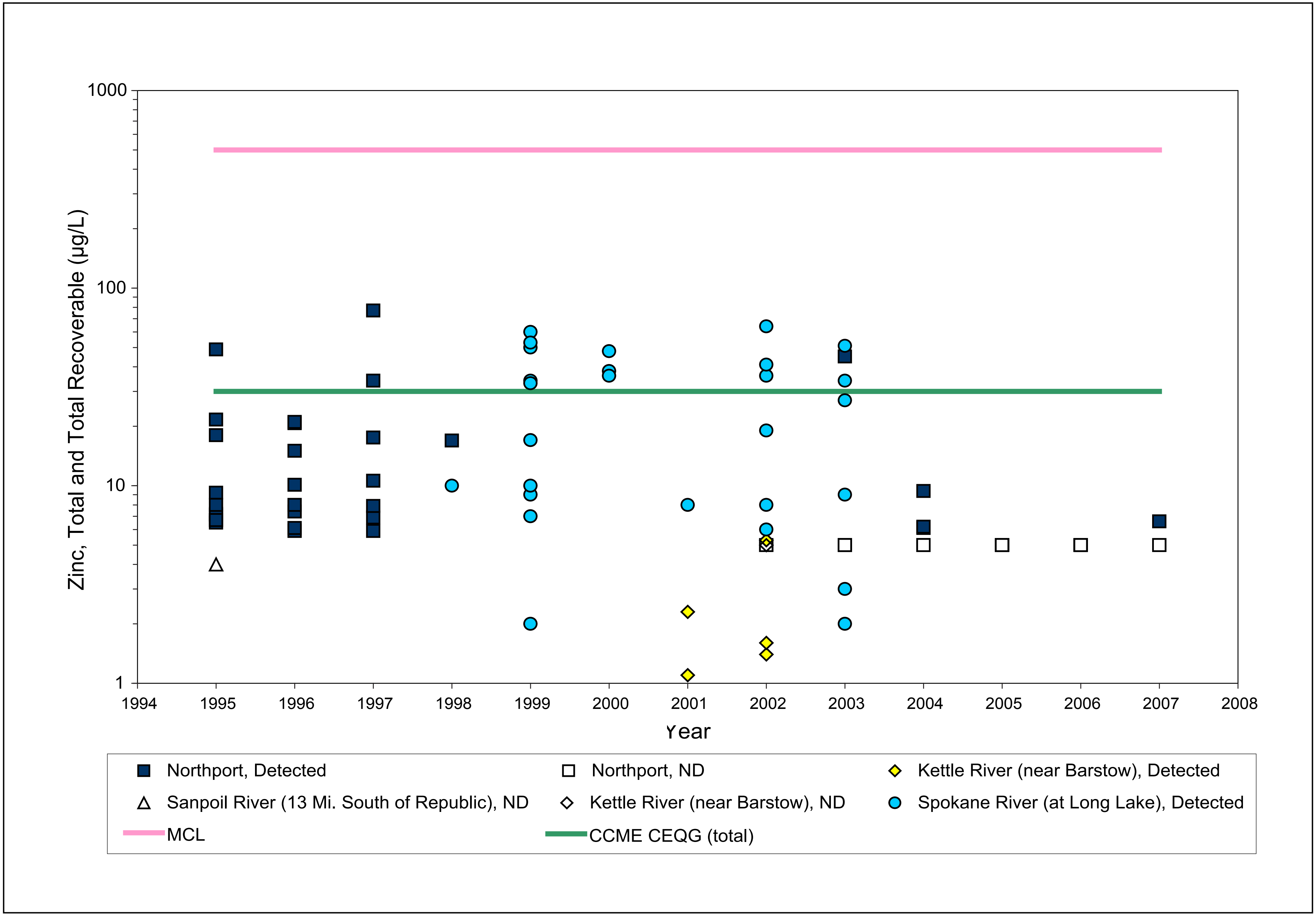


Figure 24. Available Total and Total Recoverable Zinc Concentrations, Northport and Major Tributaries (1995–2007).

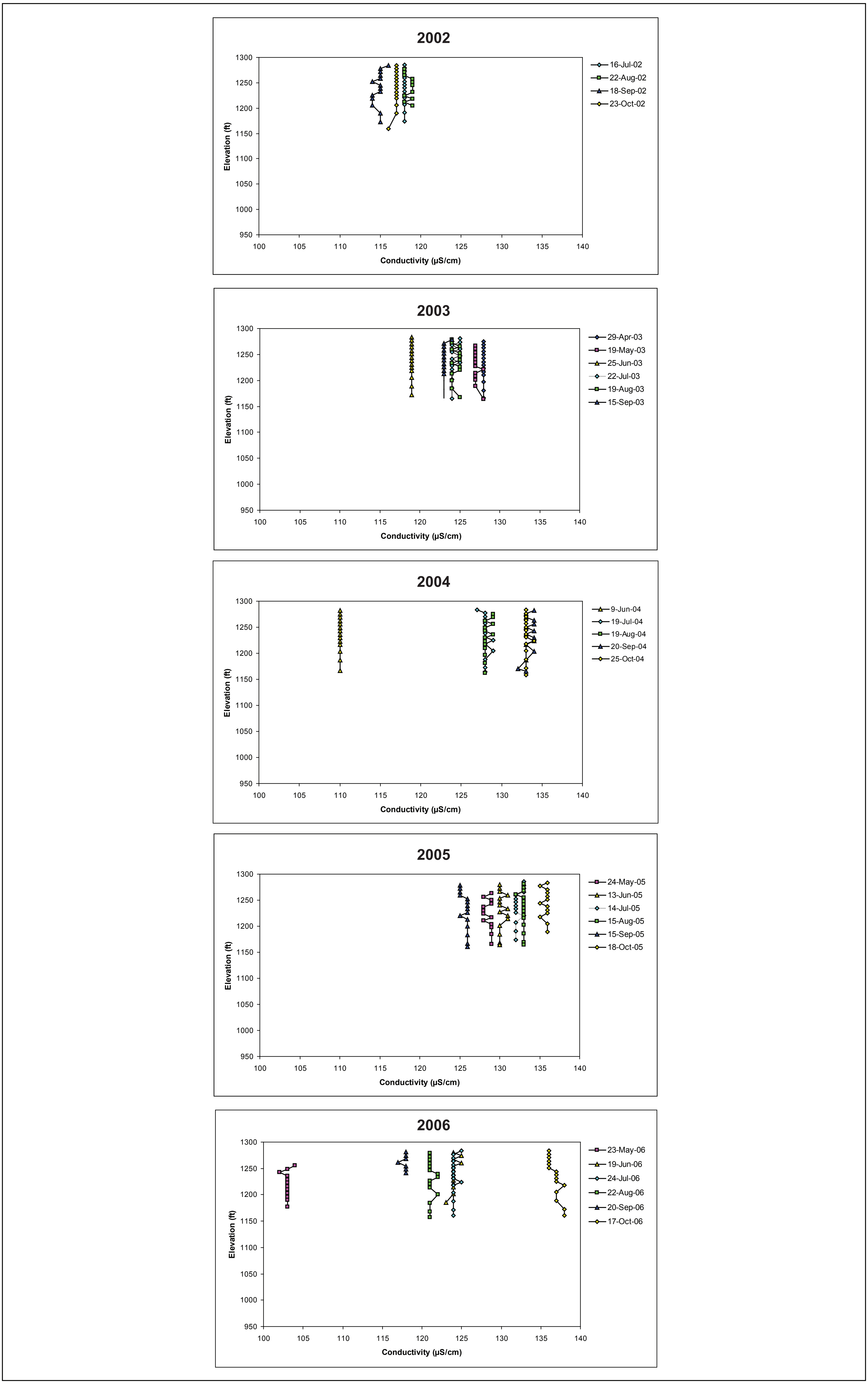


Figure 25. Conductivity Profiles from USBR Kettle Falls Station, 2002–2006.

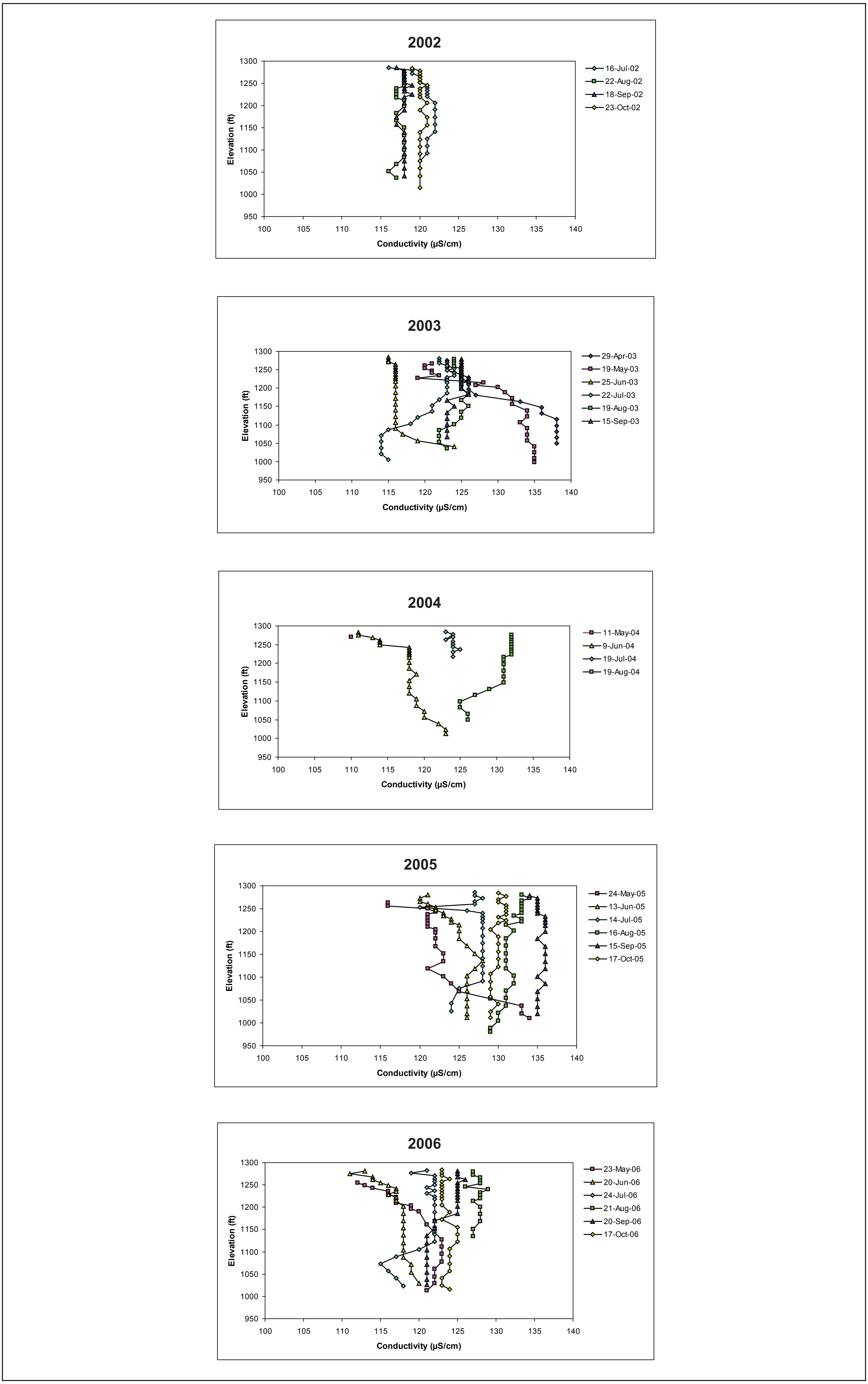


Figure 26. Conductivity Profiles from USBR Lincoln Boat Ramp Station, 2002–2006.

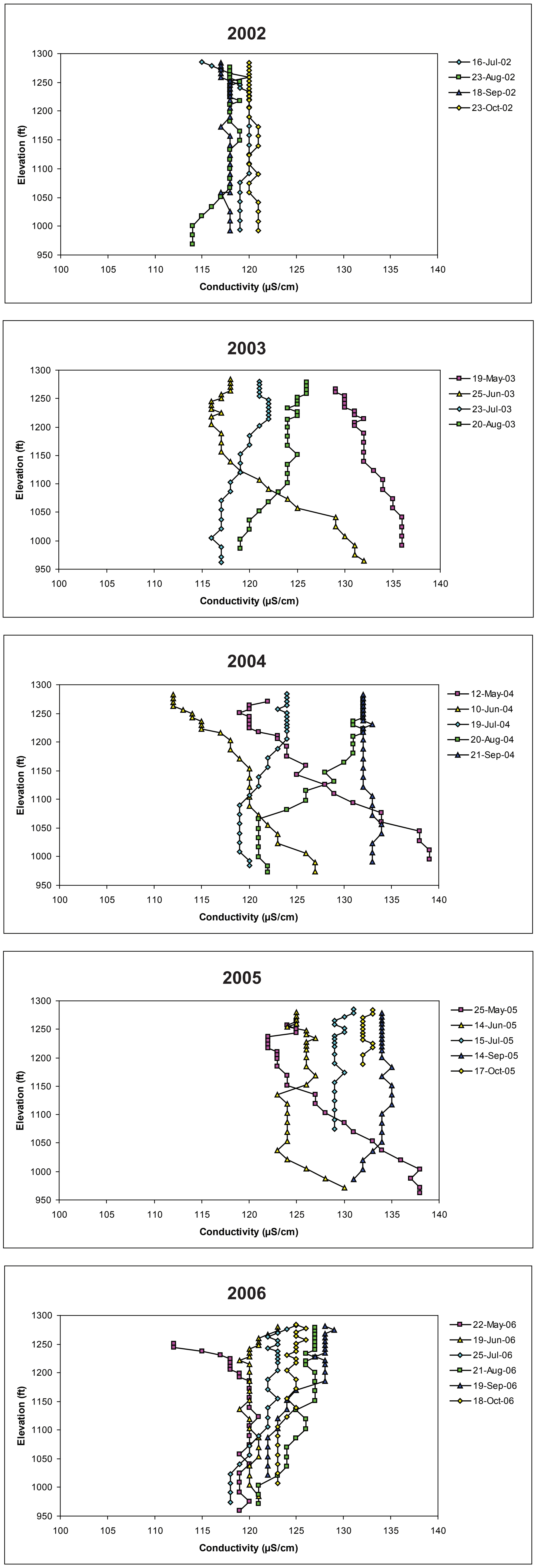


Figure 27. Conductivity Profiles from USBR Keller Ferry Station, 2002–2006.

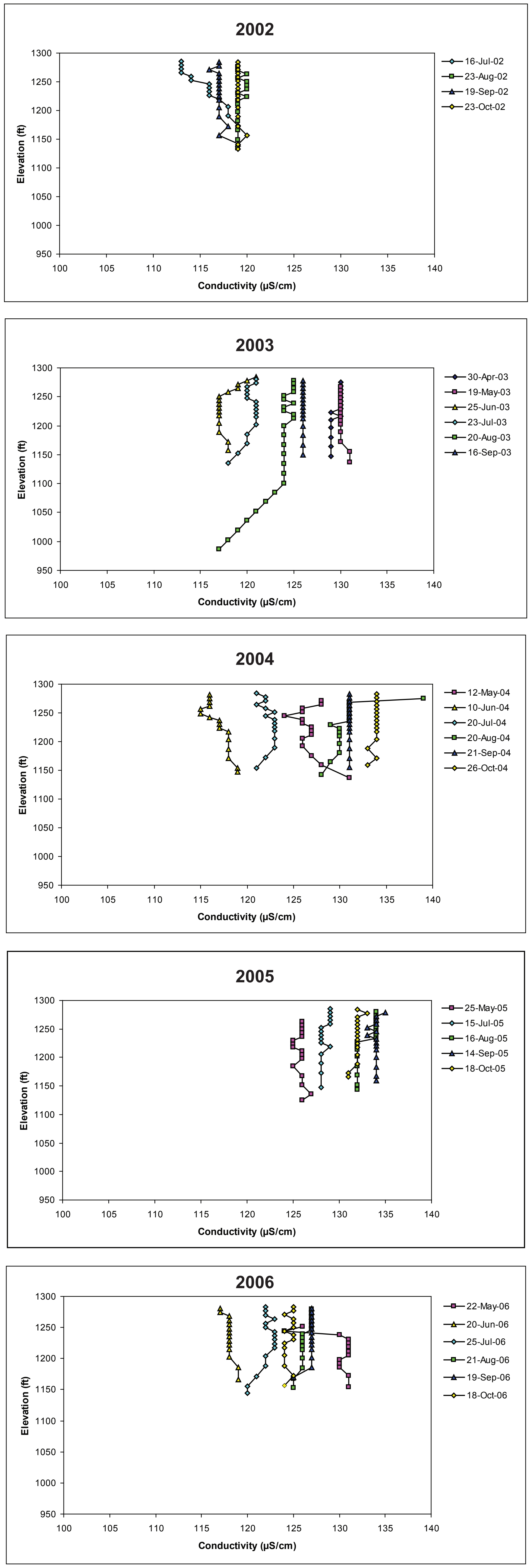


Figure 28. Conductivity Profiles from USBR Logboom Station, 2002–2006.

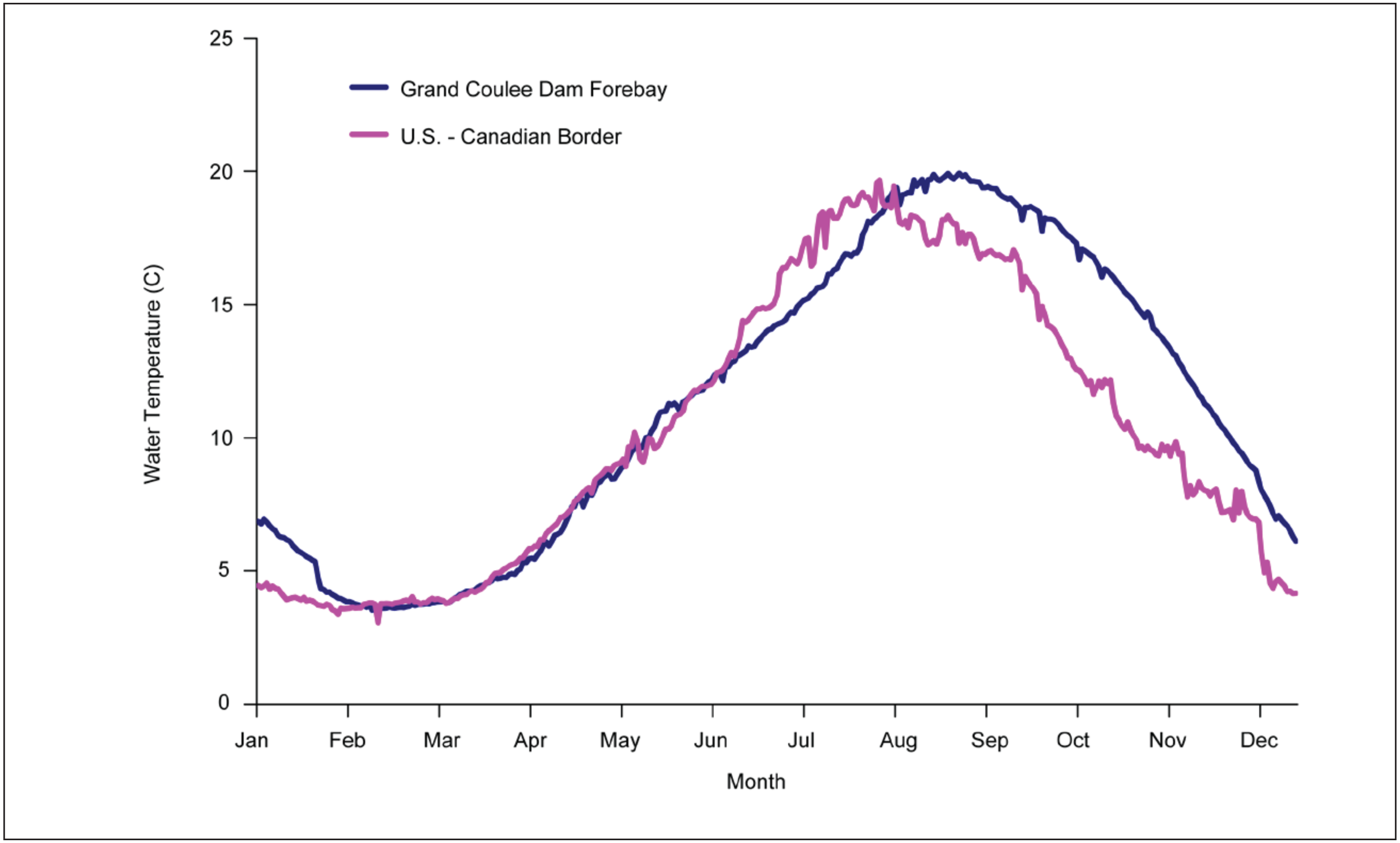


Figure 29. Daily Average Water Temperature at the International Border and Grand Coulee Dam Forebay, 1998-2003.
Data Sources: U.S. Army Corps DART (Data Access in Real Time) http://www.cqs.washington.edu/dart/dart.html (September 2006).
Grand Coulee Dam Forebay: Collected by U.S. Army Corps of Engineers, Water Management Division Year-Round Automated Station, RM 596.6 Lat 47°57’24”; Long 118°58’35”; Sensor Depth 15 ft.
U.S.-Canadian Border Boundary: U.S. Army Corps of Engineers, Water Management Division CIBW: Year-Round Automated Station, RM 746 Lat 48°58’16.9”; Long 117°38’44.9”; Sensor Depth 15 ft.
Note: Temperature measurements collected in the forebay are taken at a specific elevation and do not represent the entire water column.

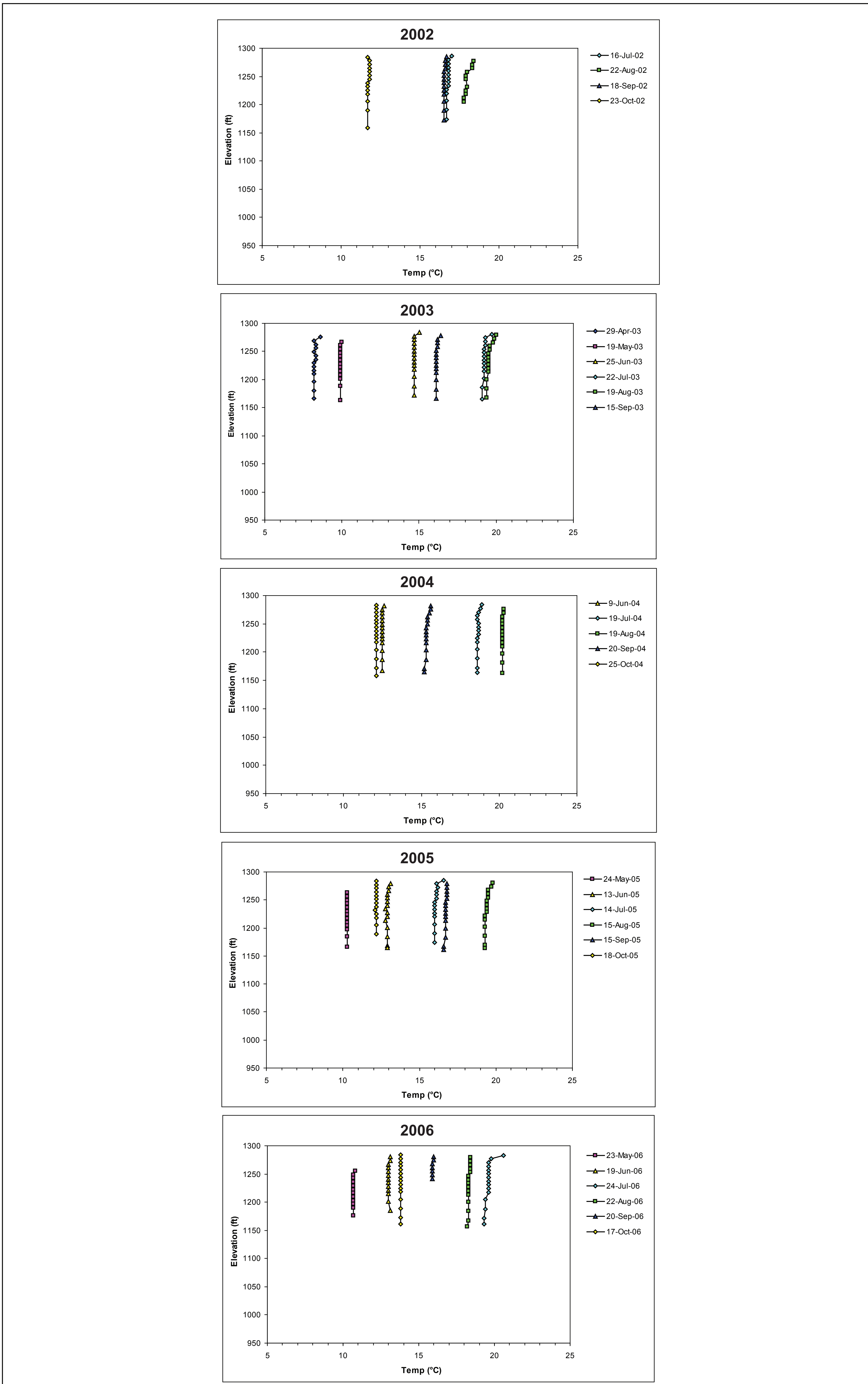


Figure 30. Temperature Profiles from USBR Kettle Falls Station, 2002–2006.

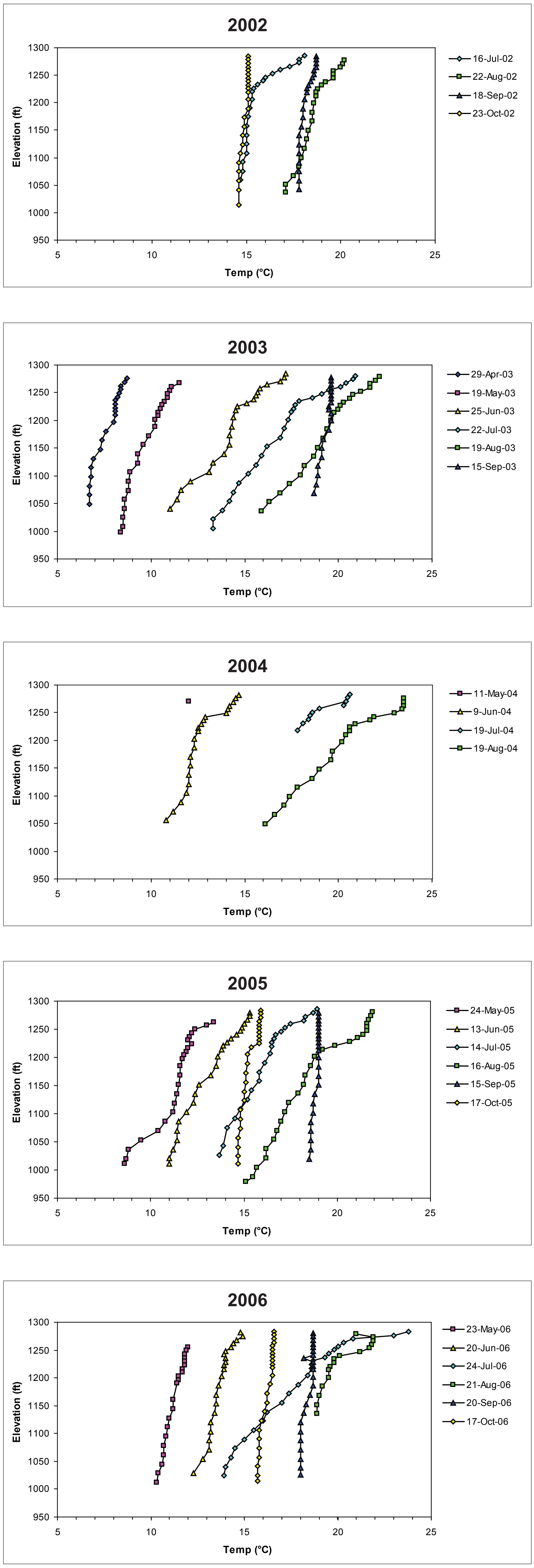


Figure 31. Temperature Profiles from USBR Lincoln Boat Ramp Station, 2002–2006.

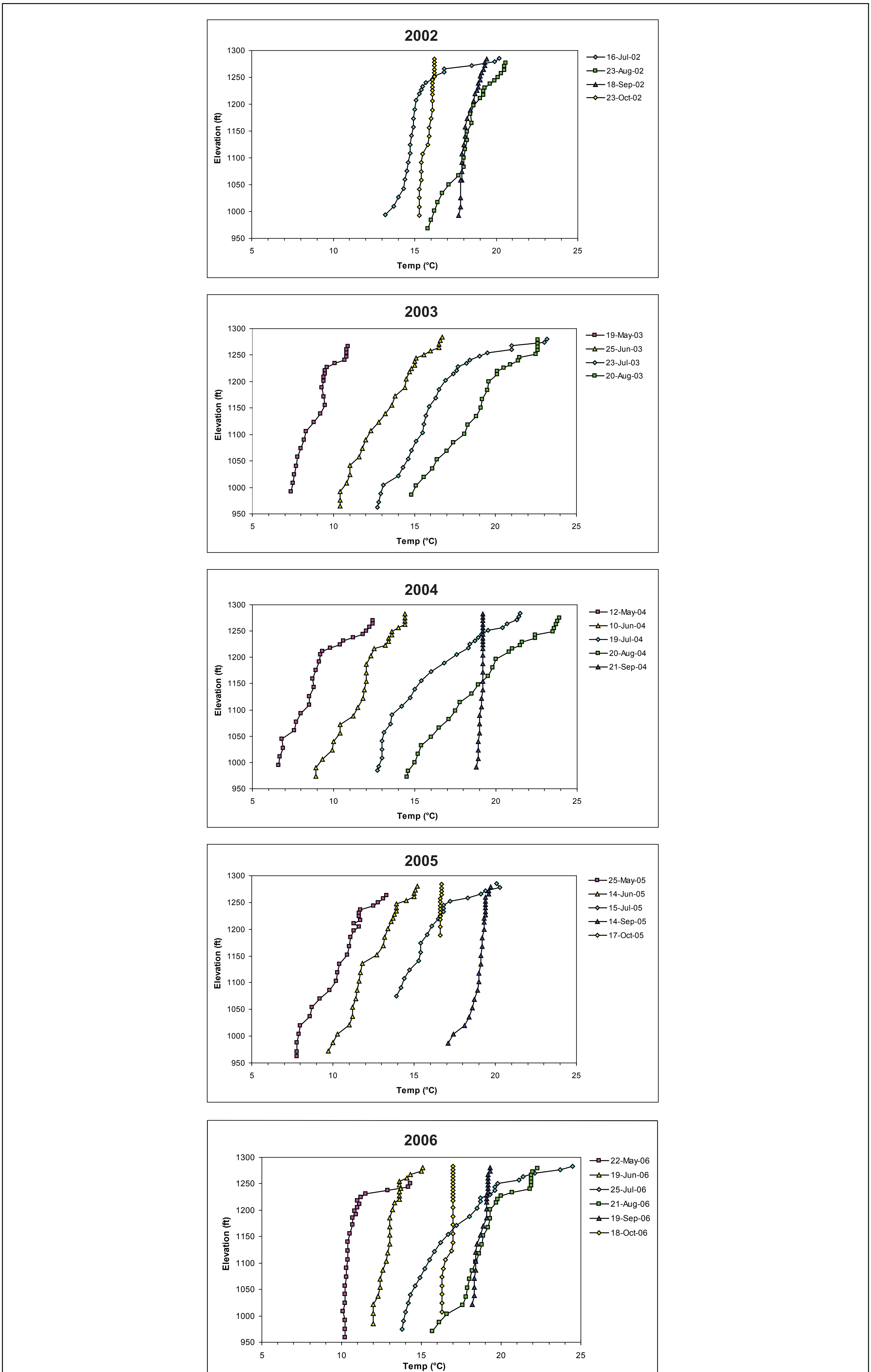


Figure 32. Temperature Profiles from USBR Keller Ferry Station, 2002–2006.

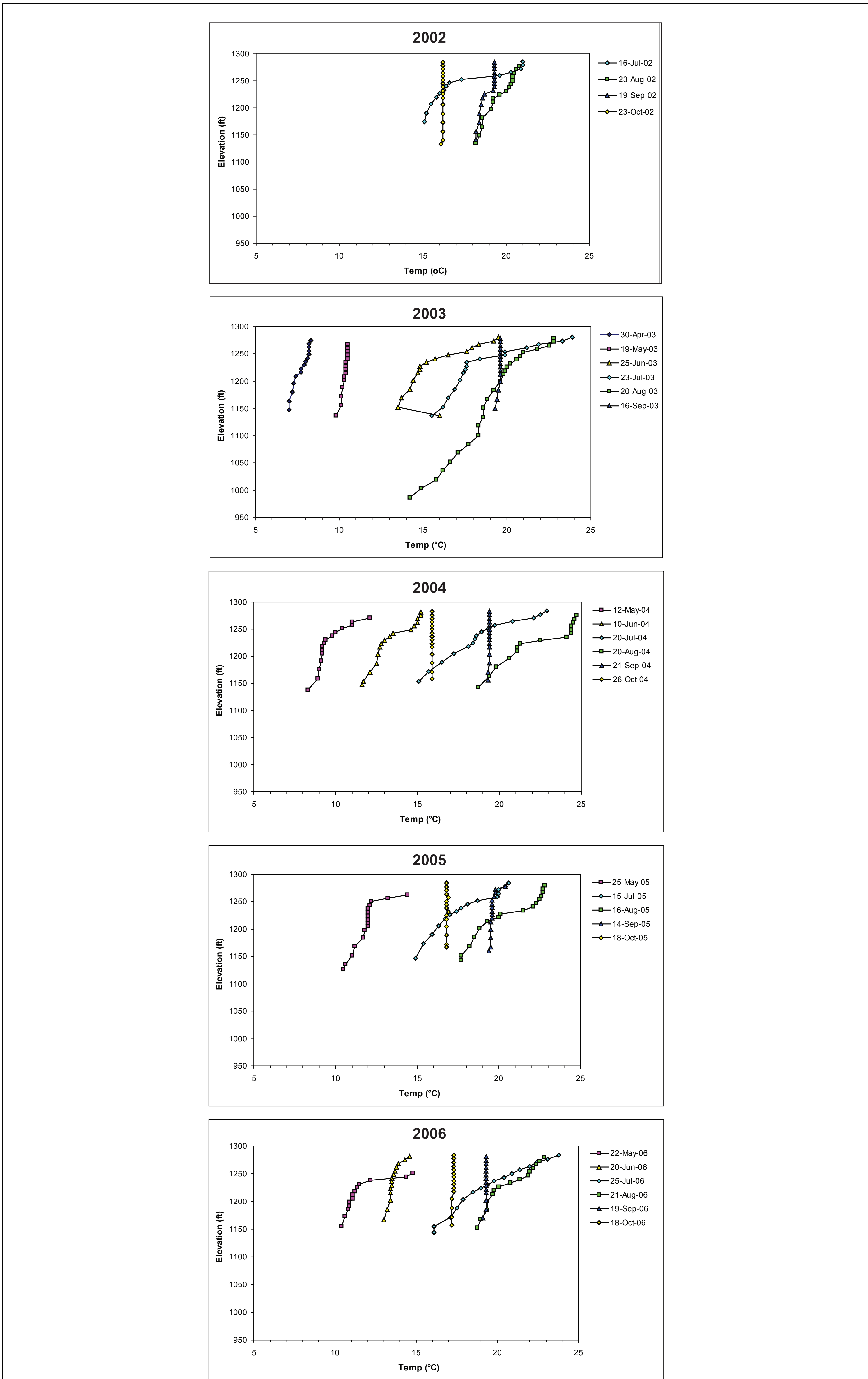


Figure 33. Temperature Profiles from USBR Logboom Station, 2002–2006.

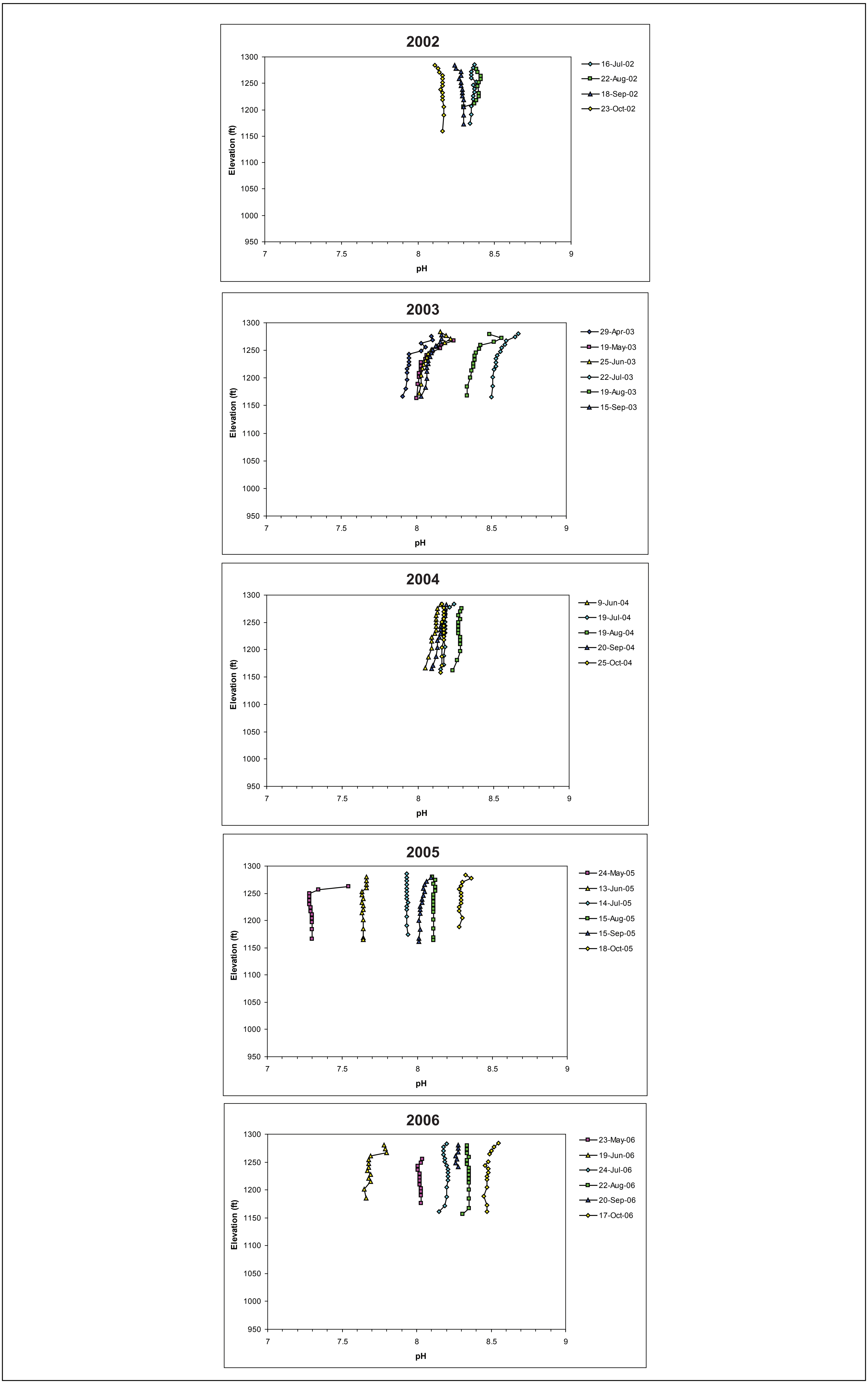
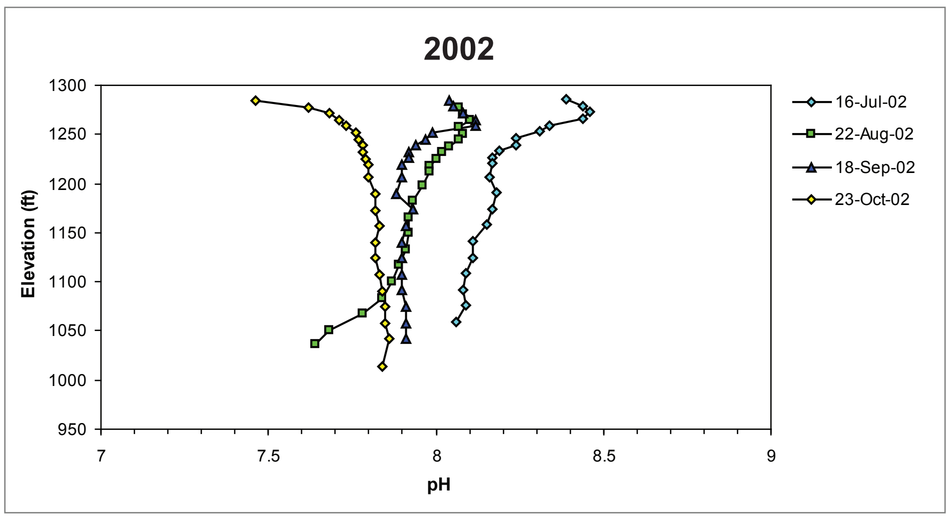
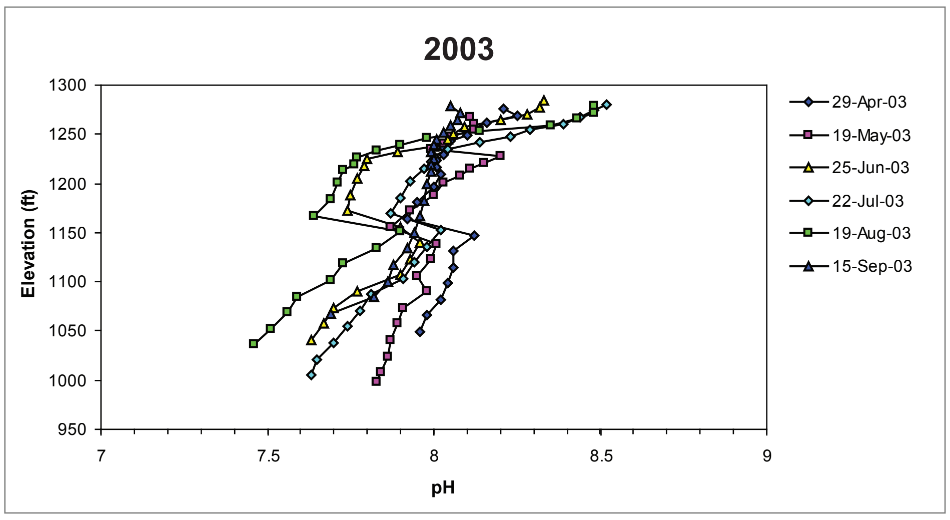
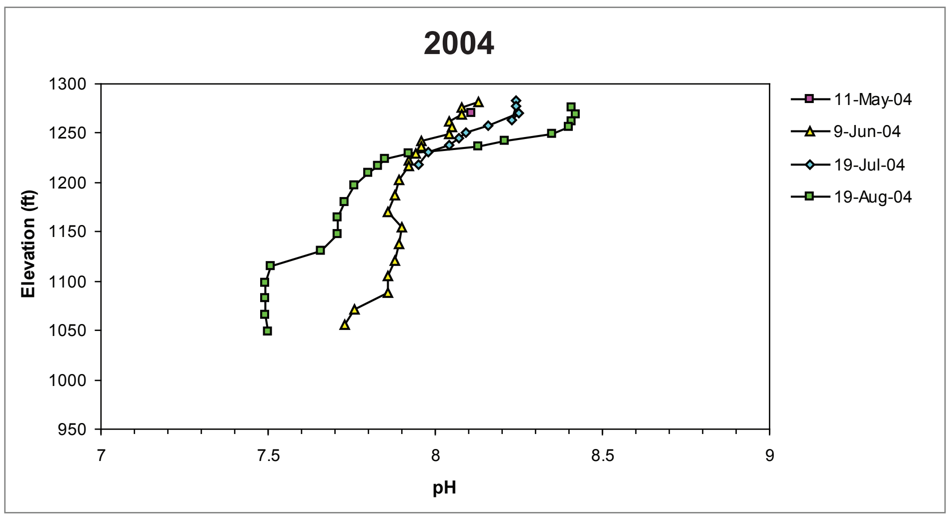
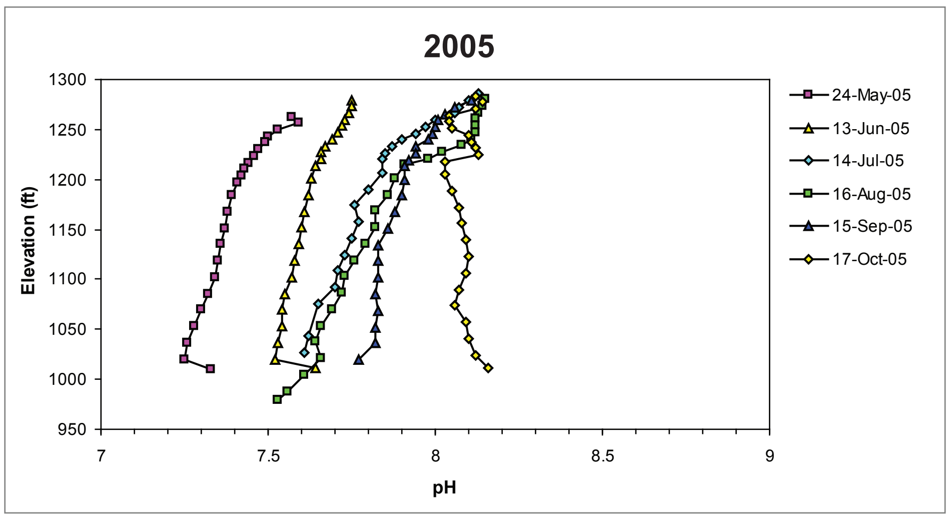


Figure 34. pH Profiles from USBR Kettle Falls Station, 2002–2006.









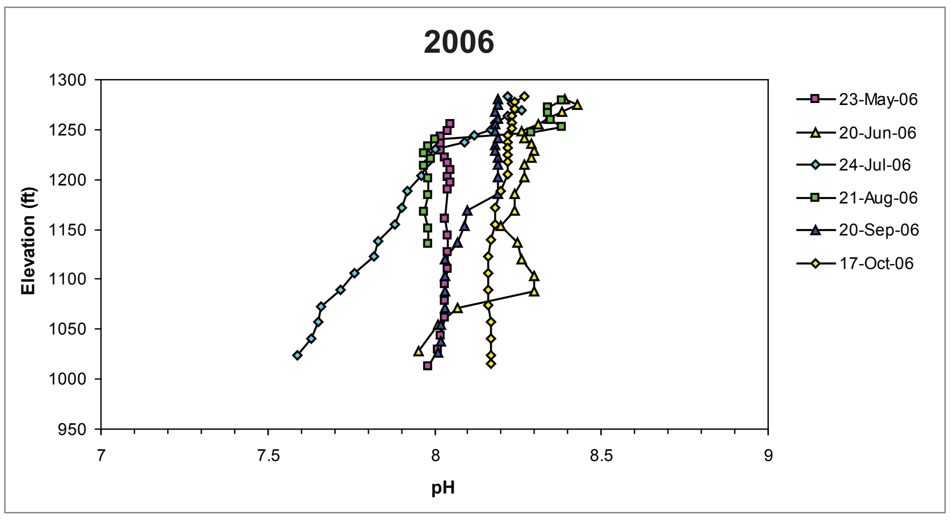
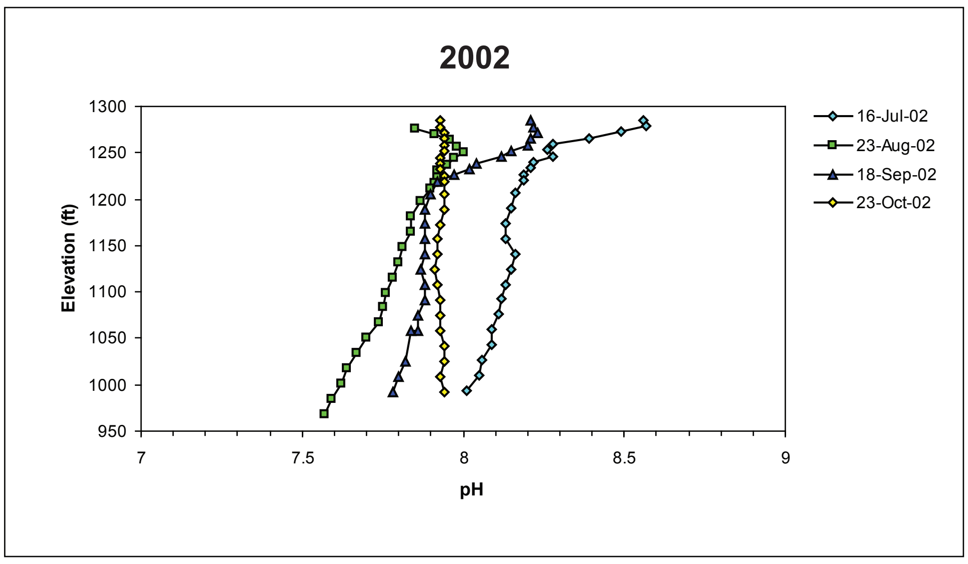
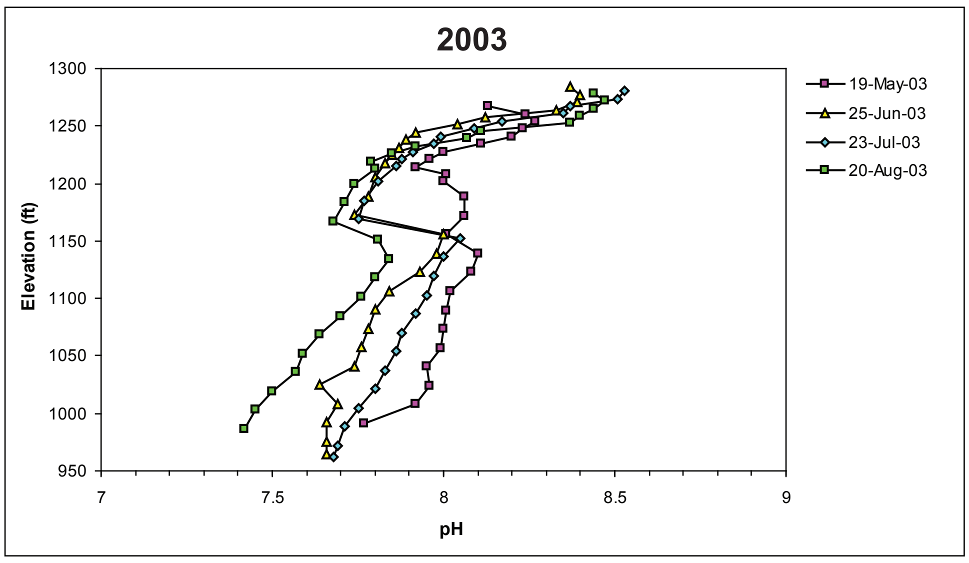
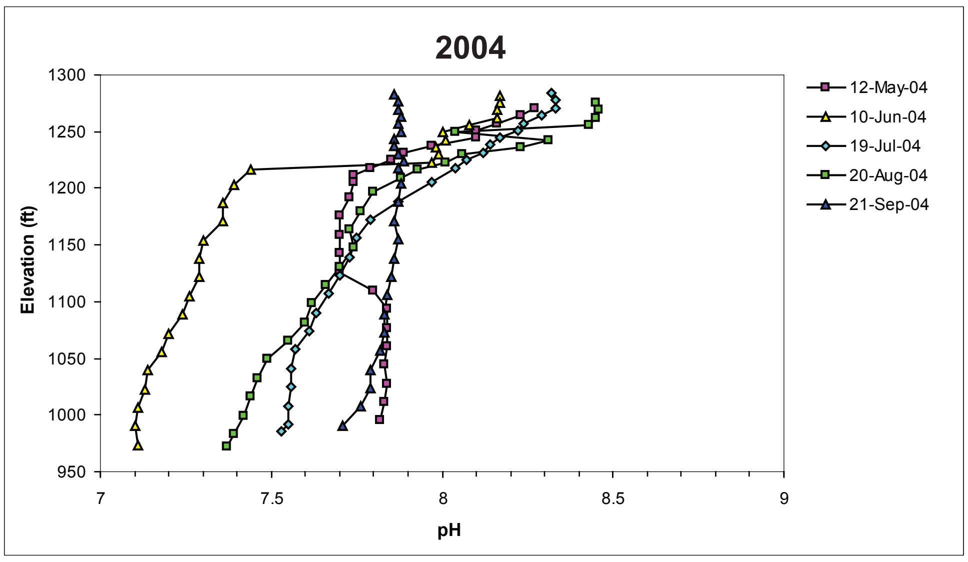
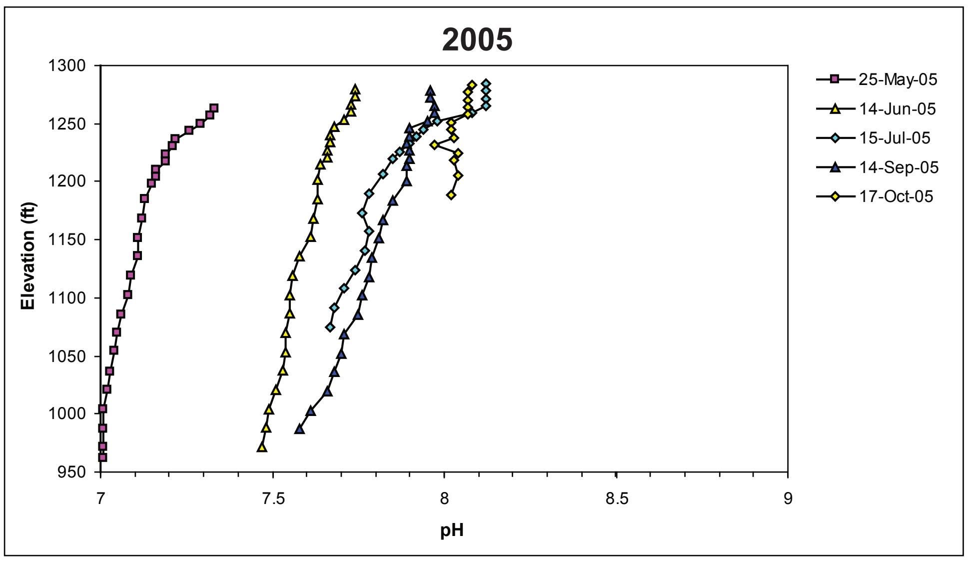


Figure 35. pH Profiles from USBR Lincoln Boat Ramp Station, 2002–2006.









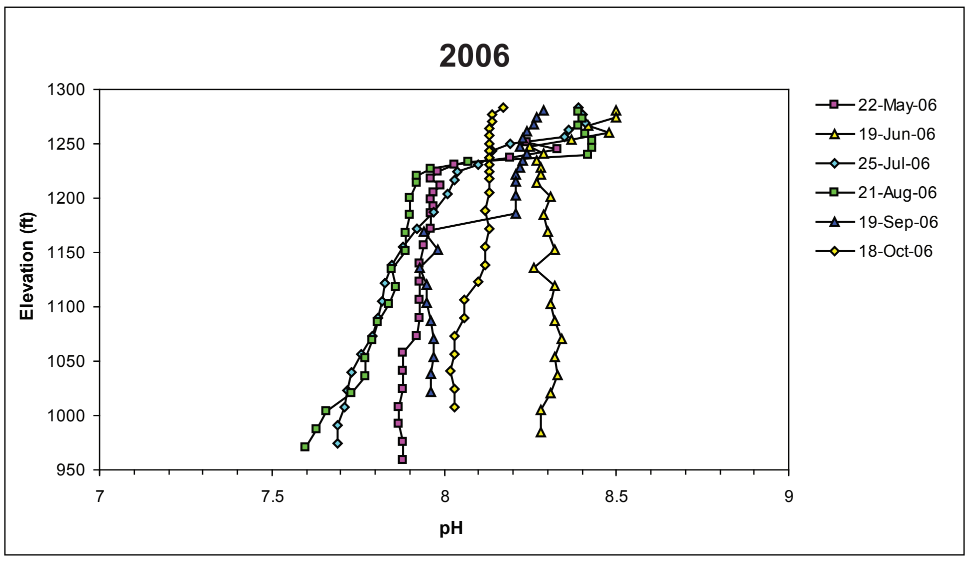


Figure 36. pH Profiles from USBR Keller Ferry Station, 2002–2006.

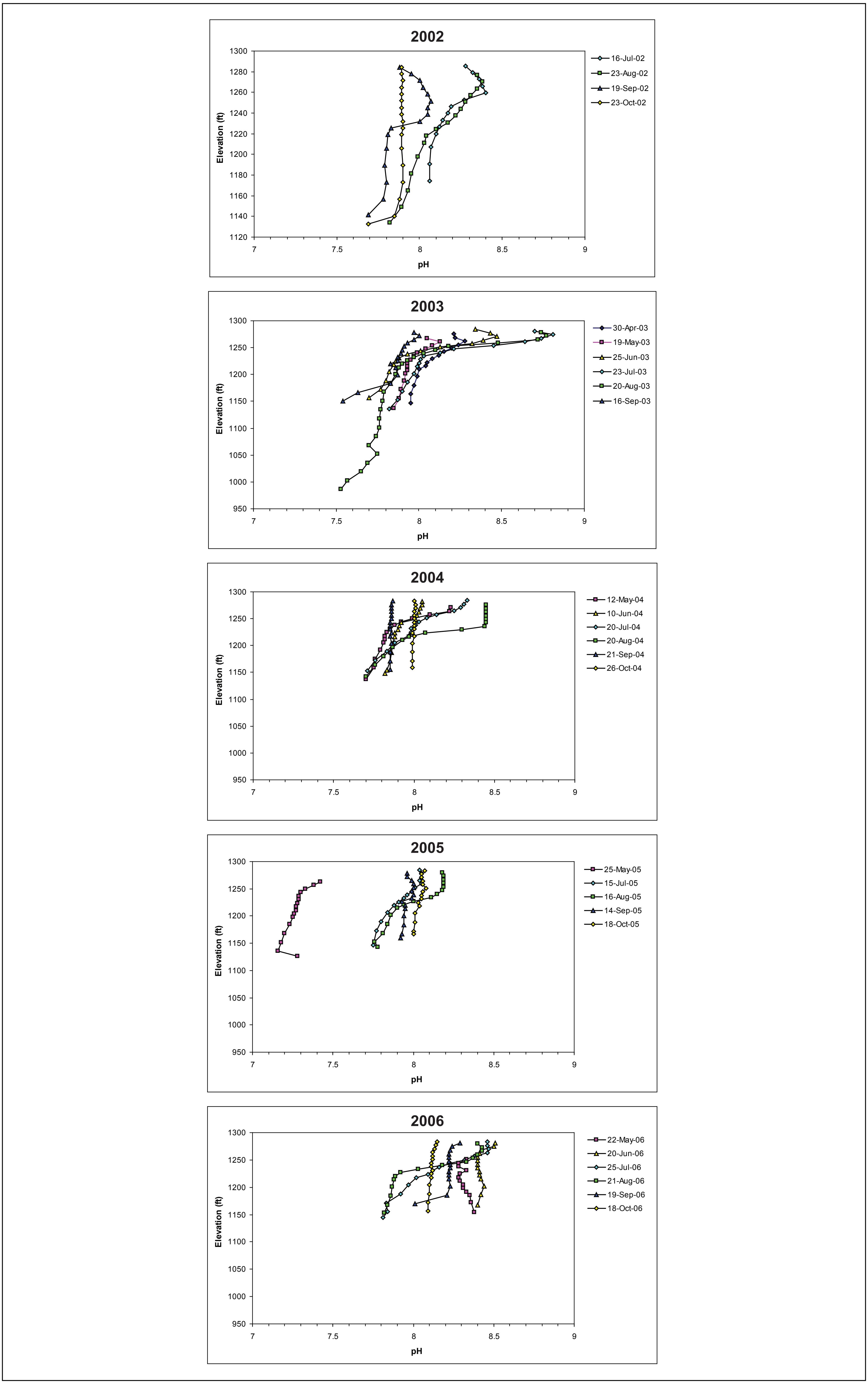


Figure 37. pH Profiles from USBR Logboom Station, 2002–2006.

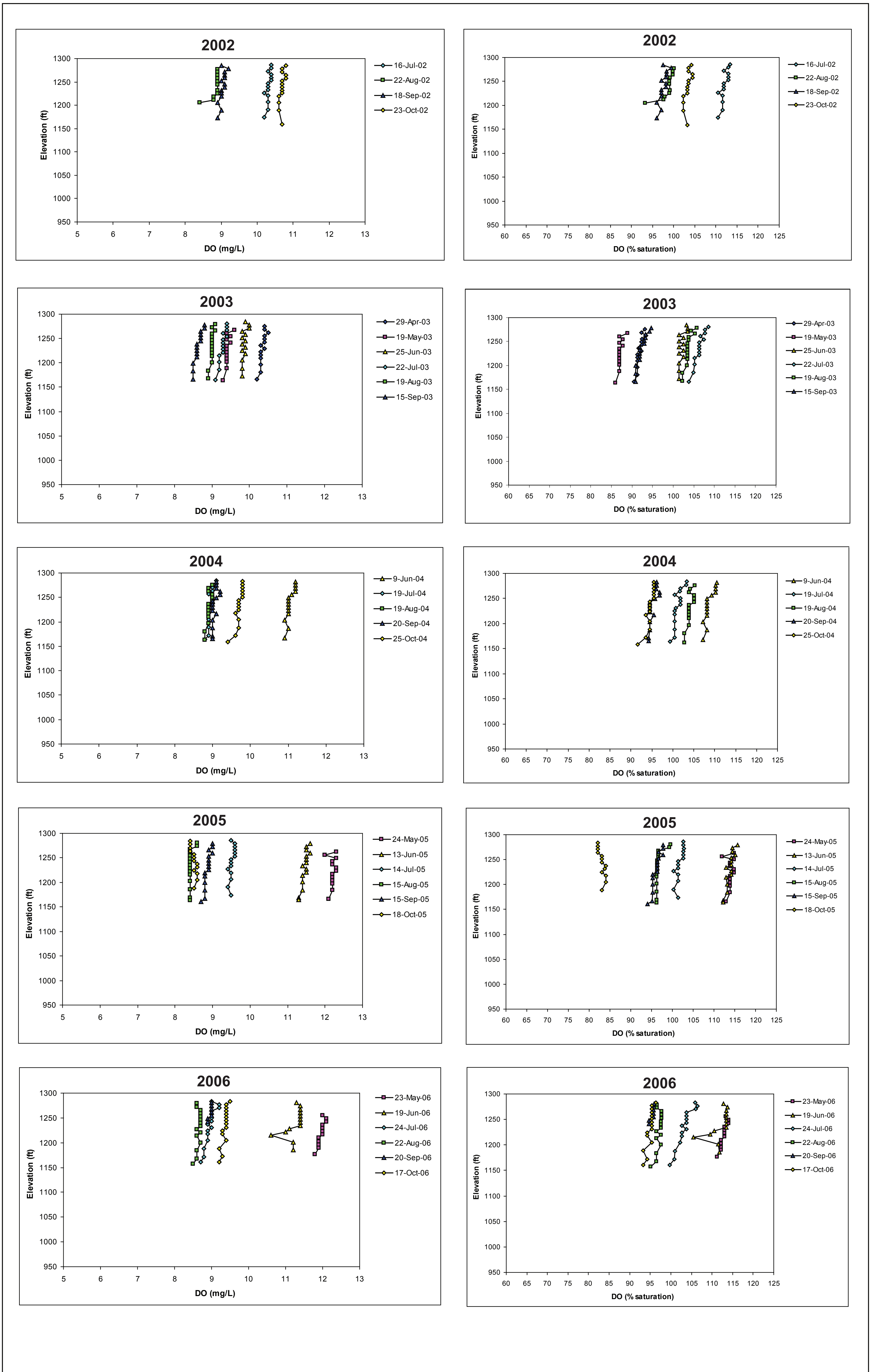


Figure 38. Dissolved Oxygen Profiles from USBR Kettle Falls Station, 2002–2006.

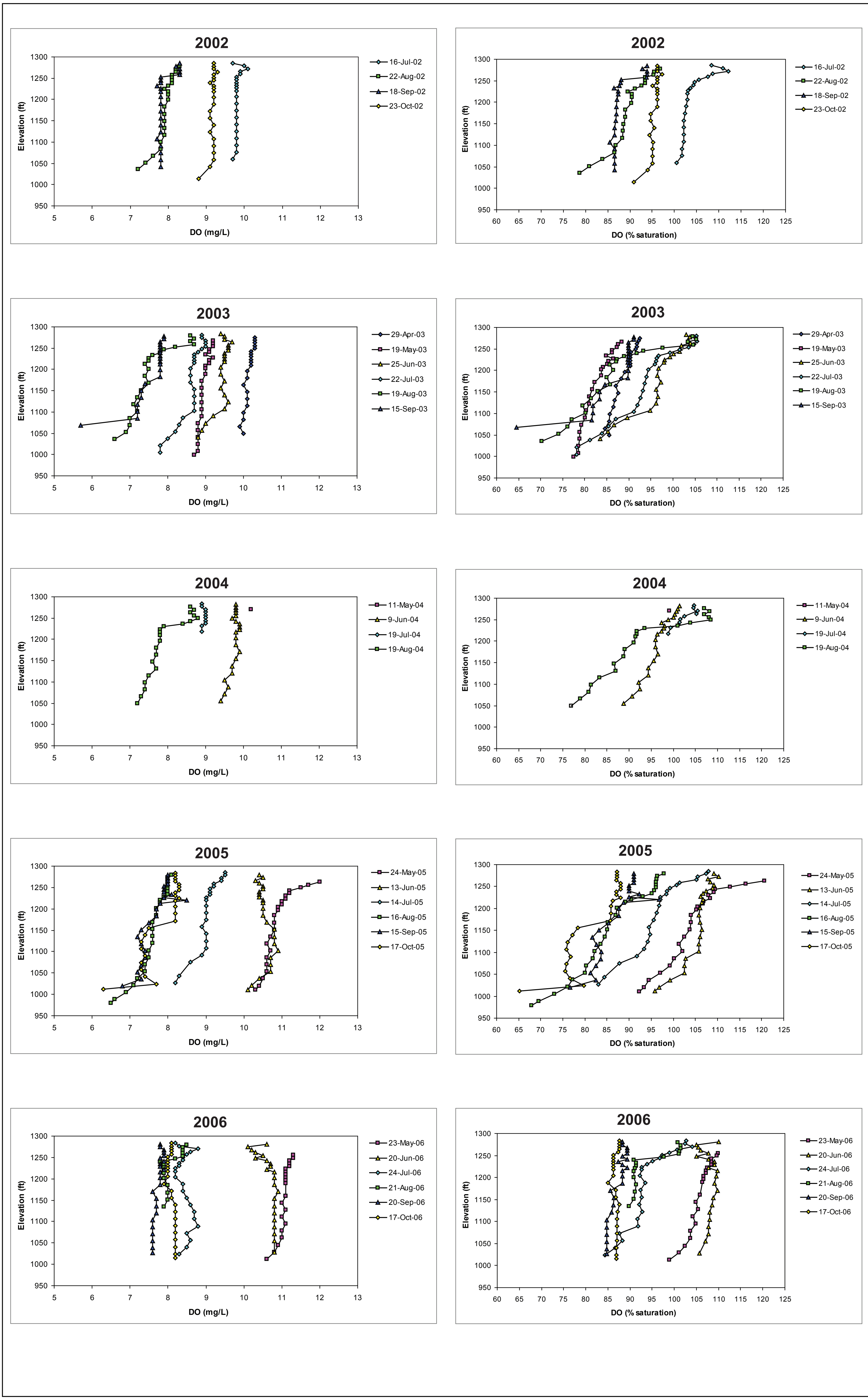


Figure 39. Dissolved Oxygen Profiles from USBR Lincoln Boat Ramp Station, 2002–2006.

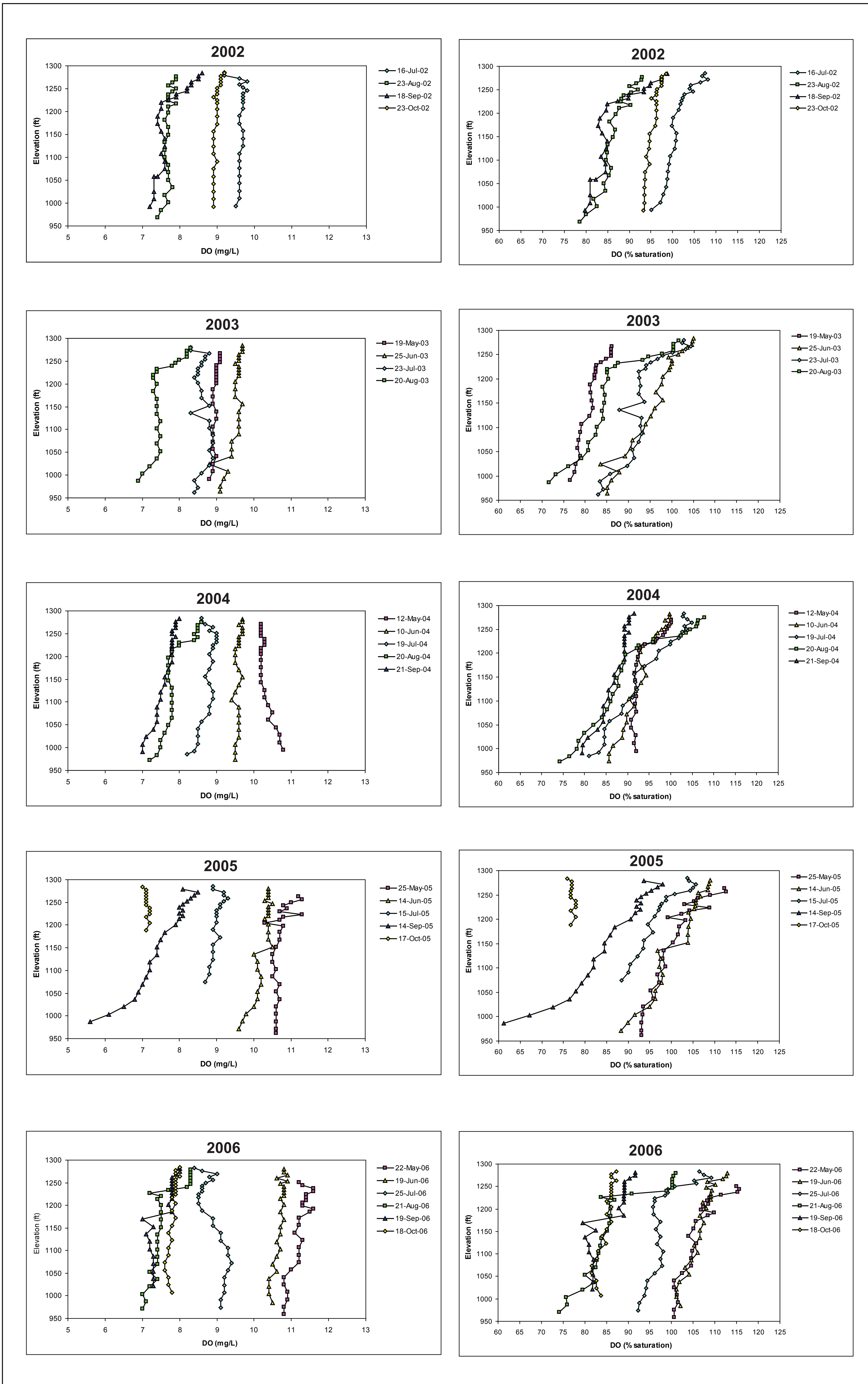


Figure 40. Dissolved Oxygen Profiles from USBR Keller Ferry Station, 2002–2006.

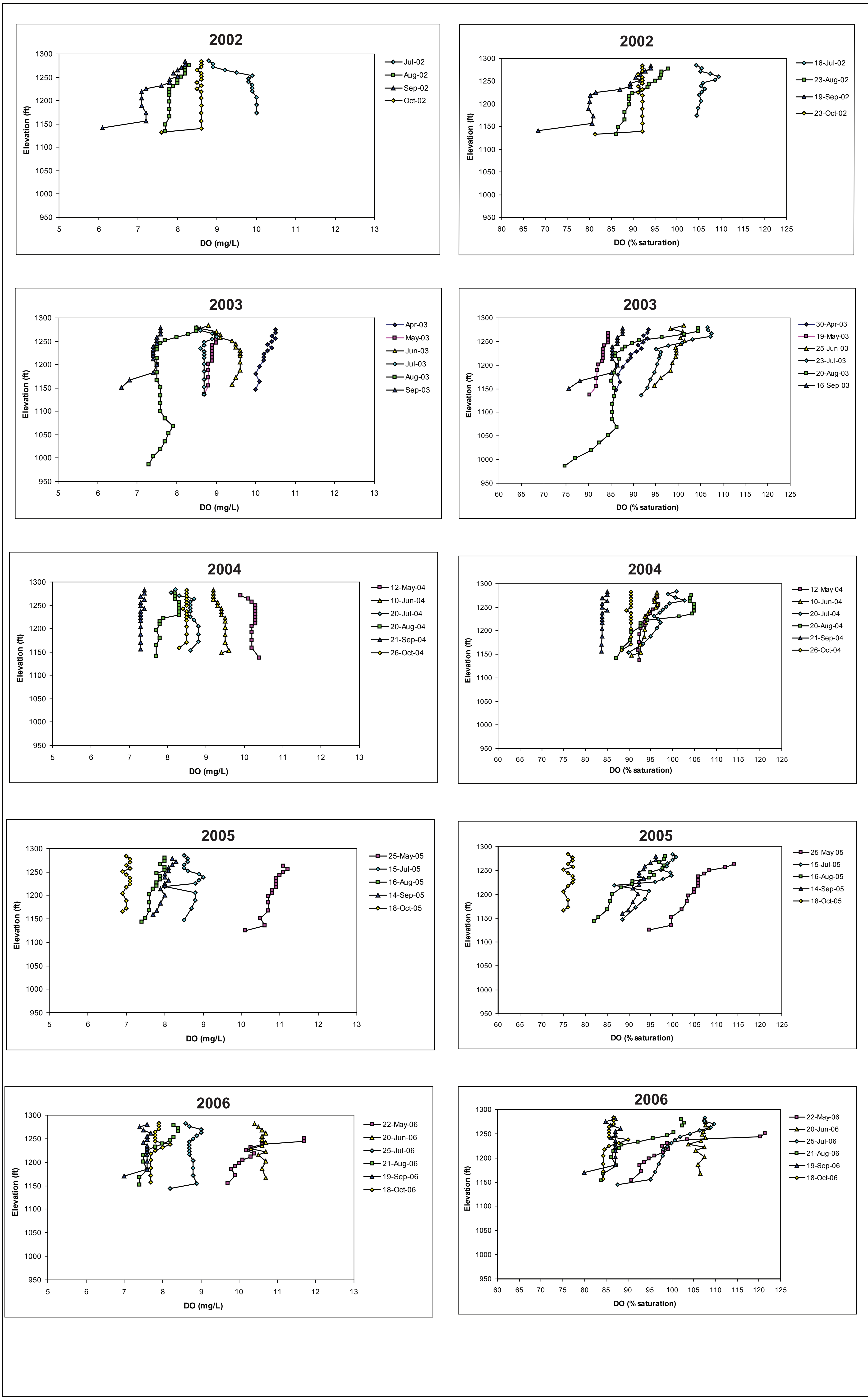


Figure 41. Dissolved Oxygen Profiles from USBR Logboom Station, 2002–2006.

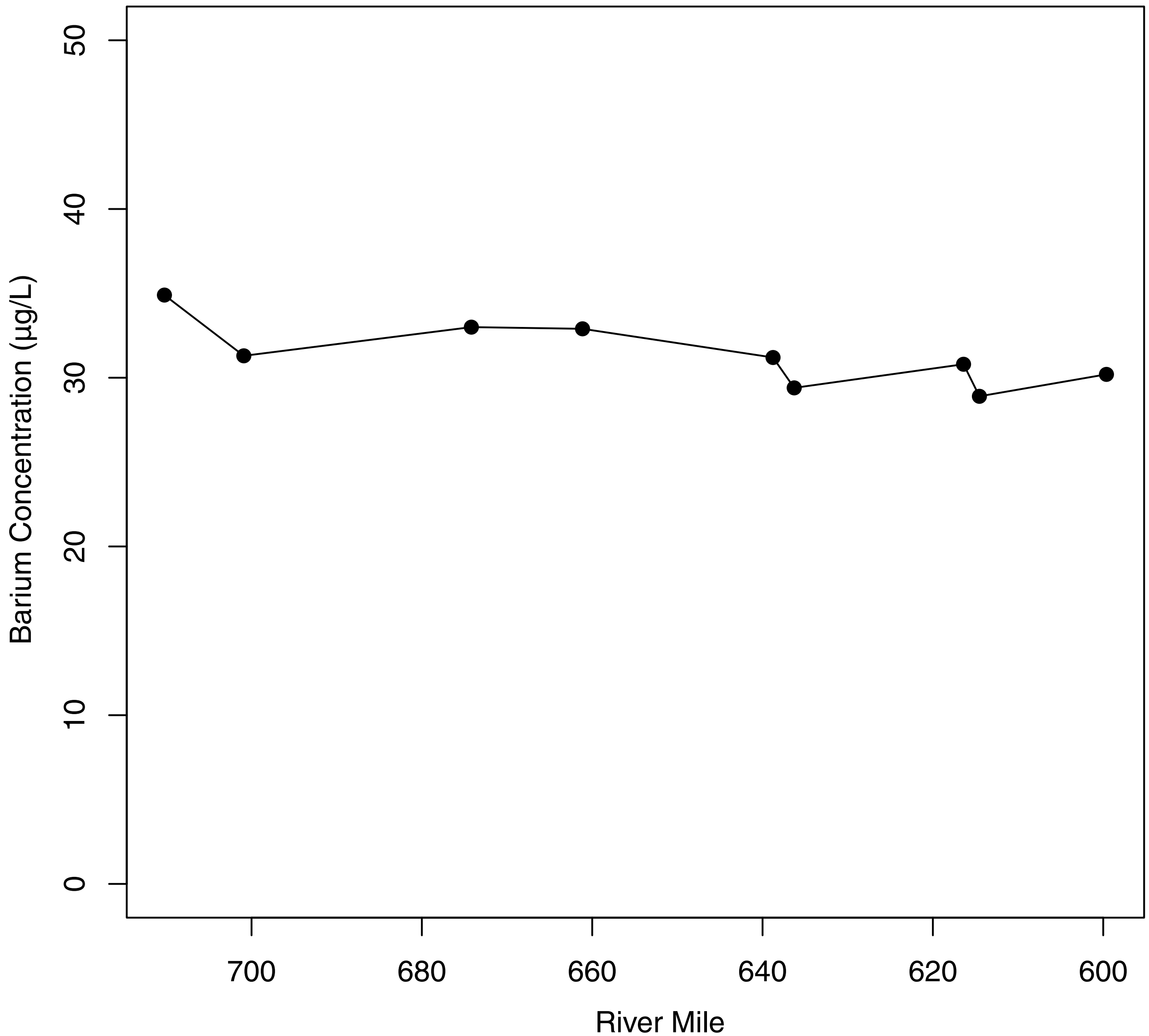


Figure 42a. Concentrations of Barium at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

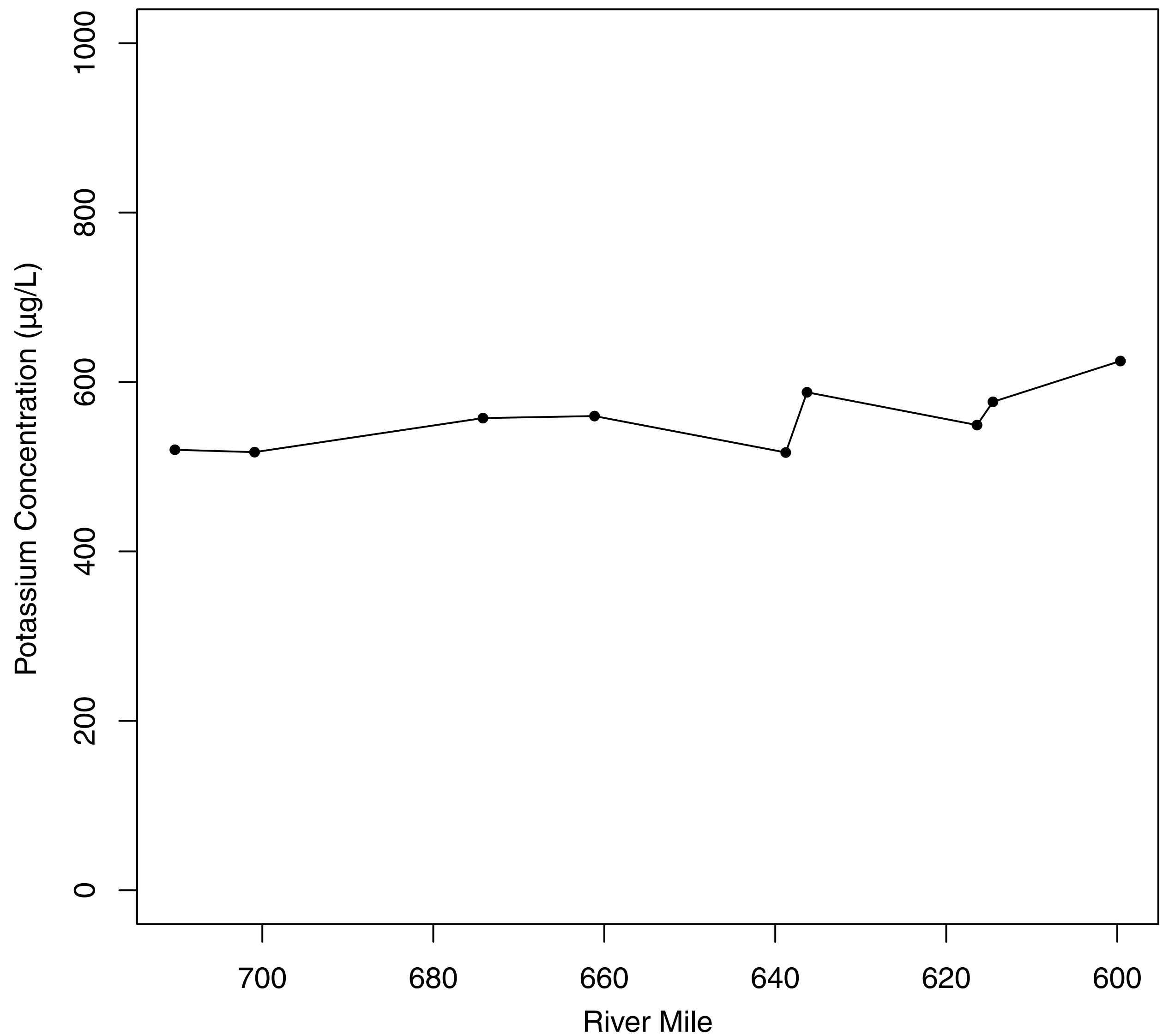


Figure 42b. Concentrations of Potassium at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

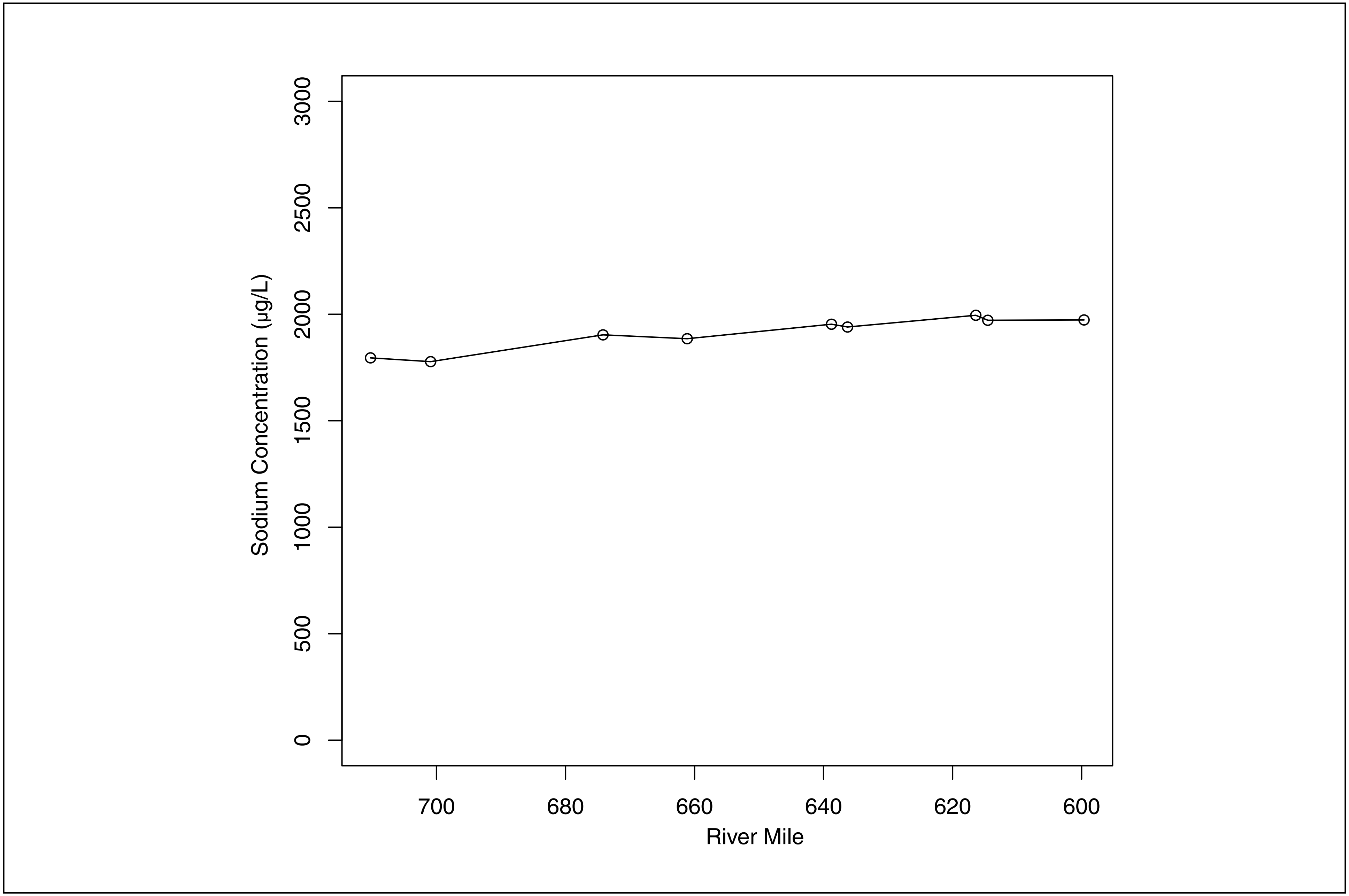


Figure 42c. Concentrations of Sodium at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

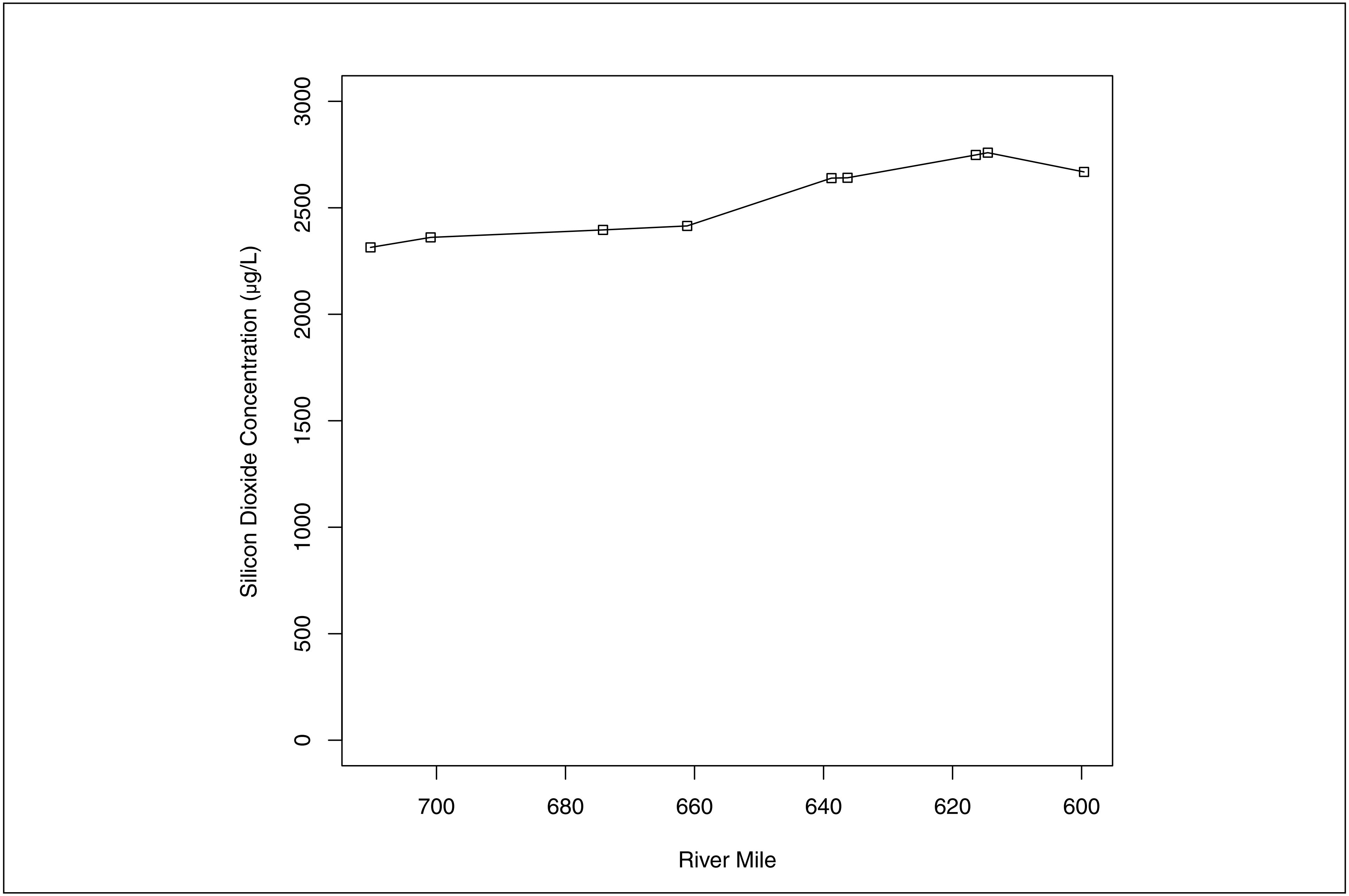


Figure 42d. Concentrations of Silicon Dioxide at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

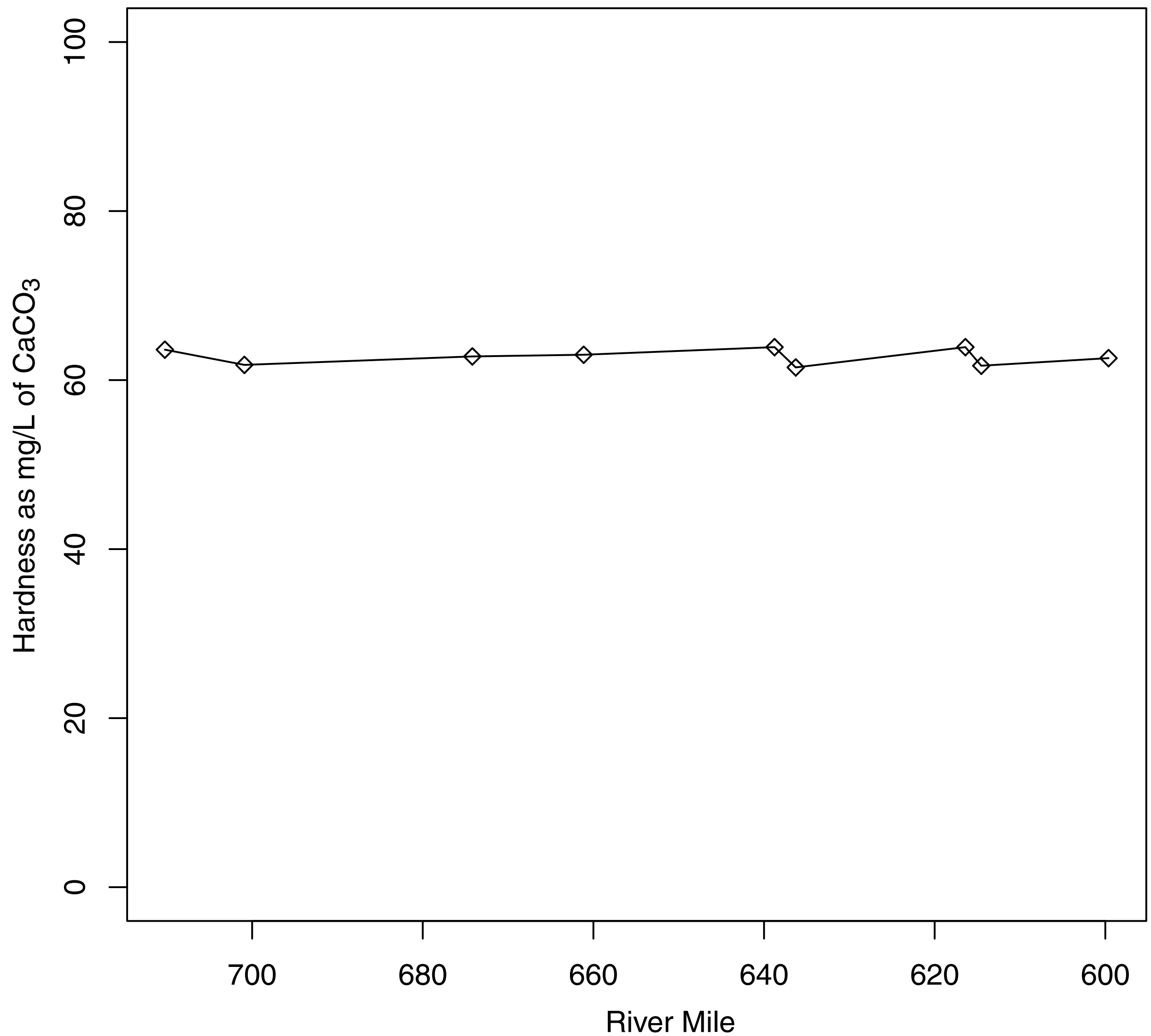


Figure 42e. Concentrations of Hardness at Multiple Locations Spanning the Length of the UCR.
Source: Scofield and Pavlik-Kunkel (2007).

TABLES

Table 1. Metals and Metalloids Identified as COIs for the UCR RI/FS (USEPA 2008).

Chemical Group	Analyte(s)
Metals and Metalloids	Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Cerium, Cesium, Chromium, Cobalt, Copper, Dysprosium, Erbium, Europium, Fluoride, Gadolinium, Gallium, Germanium, Gold, Holmium, Indium, Iron, Lanthanum, Lead, Lithium, Lutetium, Magnesium, Manganese, Mercury, Molybdenum, Neodymium, Nickel, Niobium, Potassium, Praseodymium, Rubidium, Samarium, Scandium, Selenium, Silicon, Silver, Sodium, Strontium, Sulfur, Tantalum, Tellurium, Thorium, Thulium, Tin, Thallium, Titanium, Tungsten, Uranium, Vanadium, Ytterbium, Yttrium, Zinc, Zirconium

Notes:
COI = chemical of interest

Table 2. Summary of Surface Water Metals Data Sets in the Study Area and Vicinity.

Water Body	Sample Location	Date(s)	Source
Upstream of Upper Columbia River (North of Border)			
Columbia River	Birchbank	1983-2006	Env. Canada
	Waneta	1979-2005	Env. Canada
Pend Oreille River	International Boundary	1997-2004	Env. Canada
	Waneta	1979-2007	Env. Canada
Upper Columbia River			
Columbia River/Lake Roosevelt	Northport (RM 735)	1951-2005	EIM, USGS
	LR-5A (RM 710)	2004	Paulson et al. 2006
	LR7 (RM 753)	2004	Paulson et al. 2006
	Little Dalles (RM 728)	1989	Johnson 1991
	Castle Rock (RM 645)	1989	Johnson 1991
	At Marcus Island (RM 708)	1986	Johnson et al. 1988
	Colville River At Mouth, Hwy. 25 Bridge	1986	Johnson et al. 1988
	At Gifford (RM 677)	1986	Johnson et al. 1988
	At Seven Bays (RM 634)	1986	Johnson et al. 1988
	Mid-lake (surface)	1980	STORET
	Mid-lake (50 ft)	1980	STORET
	French Point Rocks	1989	Johnson 1991
	Spokane River at Mouth	1991	NPS 1995
	Sanpoil River Near Mouth	1986	NPS 1995
	Swawilla Basin	1989	Johnson 1991
	Lake Roosevelt at Grand Coulee	2001	USEPA 2003
	Sanpoil River (RM 617)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Porcupine Bay (RM 638)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Spring Canyon (RM 600)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Keller Ferry (RM 615)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Sanpoil River Confluence (RM 616)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Seven Bays (RM 636)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Spokane River Confluence (RM 639)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Hunters (RM 661)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Gifford (RM 674)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Kettle Falls (RM 701)	1998-2000	Scofield and Pavlik-Kunkel 2007
	Evan's Landing (RM 710)	1998-2000	Scofield and Pavlik-Kunkel 2007
Downstream of Upper Columbia River (Below Grand Coulee Dam)			
Columbia River	Below Grand Coulee Dam (RM 596)	1986	Johnson et al. 1988
Tributaries to Upper Columbia River			
Alder Creek	Hwy. 25 Bridge	1986	Johnson et al. 1988
Big Sheep Creek	At mouth	1986	Johnson et al. 1988
Cleveland Mine	Unknown	1999	EIM
Colville River	At RM 5.0	1986	Johnson et al. 1988
	At Hwy 25 Bridge	1986	Johnson et al. 1988
	At Kettle Falls	1960-1972	NPS 1995
Deep Creek	At mouth	1986	Johnson et al. 1988
	South Fork	2001	USEPA 2002
Deep Creek Tributary	Tributary	2001	USEPA 2002
Hall Creek	At mouth	1986	Johnson et al. 1988
Hunters Creek	Lake Roosevelt	1986	Johnson et al. 1988
Kettle River	At Hedlund Bridge	1986	Johnson et al. 1988
	1.3 mi above Barstow	1986	Johnson et al. 1988

Table 2. Summary of Surface Water Metals Data Sets in the Study Area and Vicinity.

Water Body	Sample Location	Date(s)	Source
	Near Barstow	1971-2005	EIM
Onion Creek	Near Northport	1990-95	EIM
	At mouth	1986	Johnson et al. 1988
Sanpoil River	At mouth	1986	EIM; Johnson et al. 1988
	Near mouth	1980-1981	NPS 1995;
	Arm	1989	EIM; Johnson 1991
	13 Mi. South of Republic	1990-95	EIM
Spokane River	At Long Lake Dam	1986	Johnson et al. 1988
	Arm	1989	Johnson 1991
	Below Long Lake Dam	1972-1973	NPS 1995
	USGS at Long Lake	1998-2003	USGS
Tom Bush Creek Tributary	Unknown	2001	USEPA 2002
Unnamed tributary to Hunter's Creek	Unknown	2001	USEPA 2002
Unnamed tributary to Onion Creek	Unknown	2001	USEPA 2002

Notes:
RM = River mile
EIM = Ecology Environmental Information Management System (www.ecy.wa.gov/EIM)
Env. Canada = Environment Canada Water Quality Database (http://waterquality.ec.gc.ca/waterqualityweb/searchtext.aspx)
USGS = US Geological Survey National Water Information System (http://nwis.waterdata.usgs.gov/wa/nwis/)
STORET = USEPA Storage and Retreival Database (http://www.epa.gov/storet/index.html)

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NPS. 1995. Baseline water quality data, Inventory and analysis, Coulee Dam National Recreation Areas. Technical Report NPS/NRWRD/NRTR 95/52. February 1995. National Park Service.

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USEPA. 2002. Preliminary Assessments and Site Inspections Report Upper Columbia River Mines and Mills, Stevens County, Washington. U.S. Environmental Protection Agency. Region 10. Seattle, WA.

USEPA. 2003. Upper Columbia River Expanded Site Inspection. U.S. Environmental Protection Agency. Region 10. Seattle, WA.

Table 3. Organic Compounds Identified as COIs for the UCR RI/FS (USEPA 2008).

Chemical Group	Analyte(s)
Semivolatile Organic Compounds (SVOCs)	1,1'-Biphenyl, 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,2'-oxybis(1-chloropropane), 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylphenol (o-cresol), 2-Nitroaniline, 2-Nitrophenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenylether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Methylphenol (p-cresol), 4-Nitroaniline, 4-Nitrophenol, Acetophenone, Benzaldehyde, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Caprolactam, Carbazole, Dibenzofuran, Diethyl phthalate, Dimethyl phthalate, Di-n-butyl phthalate, Di-n-octylphthalate, 1-Phenyl-ethanone, Hexachlorobenzene, Hexachlorocyclopentadiene, Hexachloroethane, Isophorone, Nitrobenzene, N-Nitrosodi-n-propylamine, N-Nitrosodiphenylamine, Pentachlorophenol, Perchlorocyclopentadiene, Phenol
Polycyclic Aromatic Hydrocarbons (PAHs)	***High Molecular Weight PAHs:*** Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Indeno[1,2,3-cd]pyrene ***Low Molecular Weight PAHs:*** Anthracene, 2-Methylnaphthalene, Acenaphthene, Acenaphthylene, Fluoranthene, Fluorene, Naphthalene, Phenanthrene, Pyrene
Pesticides	2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aldrin, alpha-BHC, alpha-Chlordane, Atrazine, beta-BHC, cis-Nonachlor, delta-BHC, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin aldehyde, Endrin ketone, gamma-BHC (Lindane), gamma-Chlordane, Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Hexachlorobutadiene, Methoxychlor, Oxychlordane, Toxaphene, trans-Nonachlor
Polychlorinated Biphenyls (PCBs)	Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, PCB Congeners (209 forms)
Polybrominated Diphenylethers (PBDEs)	PBDE-47, PBDE-66, PBDE-71, PBDE-99, PBDE-100, PBDE-138, PBDE-153, PBDE-154, PBDE-183, PBDE-184, PBDE-191, PBDE-209
Polychlorinated Dibenzo-*p*-Dioxins (PCDDs)	1,2,3,4,6,7,8-Heptachlorodibenzodioxin, 1,2,3,4,7,8-Hexachlorodibenzodioxin, 1,2,3,6,7,8-Hexachlorodibenzodioxin, 1,2,3,7,8,9-Hexachlorodibenzodioxin, 1,2,3,7,8-Pentachlorodibenzodioxin, 2,3,7,8-Tetrachlorodibenzodioxin, Octachlorodibenzodioxin
Polychlorinated Dibenzofurans (PCDFs)	1,2,3,4,6,7,8-Heptachlorodibenzofuran, 1,2,3,4,7,8,9-Heptachlorodibenzofuran, 1,2,3,4,7,8-Hexachlorodibenzofuran, 1,2,3,6,7,8-Hexachlorodibenzofuran, 1,2,3,7,8,9-Hexachlorodibenzofuran, 1,2,3,7,8-Pentachlorodibenzofuran, 2,3,4,6,7,8-Hexachlorodibenzofuran, 2,3,4,7,8-Pentachlorodibenzofuran, 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Octachlorodibenzofuran

Table 4. Summary Statistics for Total and Dissolved Metals Concentrations Measured at Northport[a].

						Detected Results						Detected and Undetected Results					
Analyte	Sample Date Range	Units	N	N Detected	Frequency of Detection	Min	Max	Mean	Median	25th Percentile	75th Percentile	Min	Max	Mean	Median	25th Percentile	75th Percentile
Total																	
Arsenic	10/9/1974 - 6/4/2007	µg/L	95	75	79%	0.19	3	0.62	0.47	0.375	0.78	0.19	30 *U*	3.14	0.55	0.39	1
Barium	10/7/1977 - 7/15/1982	µg/L	12	4	33%	100	200	175	200	175	200	100	200	125	100	100	125
Cadmium	10/9/1974 - 6/4/2007	µg/L	76	8	11%	0.04	0.53	0.17	0.12	0.085	0.18	0.04	20 *U*	3.2	0.1	0.1	1.25
Chromium	1/14/1975 - 6/4/2007	µg/L	75	12	16%	0.17	20	5.316	0.685	0.2925	10	0.17	20	4.3	0.5	0.5	5
Cobalt	10/9/1974 - 7/15/1982	µg/L	16	0	0%	--	--	--	--	--	--	1 *U*	100 *U*	75	100	75.5	100
Copper	10/9/1974 - 6/4/2007	µg/L	83	73	88%	0.49	80	6.6	1.5	0.84	4.58	0.49	80	8	2	0.885	17
Iron	10/9/1974 - 7/15/1982	µg/L	27	27	100%	20	590	206	160	75	255	20	590	206	160	75	255
Lead	10/9/1974 - 6/4/2007	µg/L	72	55	76%	0.12	12.1	0.8	0.5	0.26	0.8	0.12	200 *U*	32.9	0.7	0.315	4.9
Manganese	10/9/1974 - 7/15/1982	µg/L	27	14	52%	10	80	26	20	20	30	10	80	18	10	10	20
Mercury	10/9/1974 - 6/4/2007	µg/L	91	27	30%	0.001	0.3	0.065	0.003	0.002	0.1	0.001	0.5 *U*	0.093	0.002	0.002	0.1
Nickel	5/13/1982 - 6/4/2007	µg/L	34	29	85%	0.46	0.95	0.68	0.66	0.58	0.77	0.46	10 *U*	1	0.68	0.595	0.9
Selenium	10/9/1974 - 7/15/1982	µg/L	24	0	0%	--	--	--	--	--	--	1 *U*	1 *U*	1	1	1	1
Silver	10/7/1977 - 6/4/2007	µg/L	40	5	13%	1	4	2	2	1	3	0.1 *U*	20 *U*	1	0.1	0.1	1
Zinc	10/9/1974 - 6/4/2007	µg/L	89	63	71%	4.2	160	39	21	7.3	60	4.2	160	29	8	5	50
Dissolved																	
Aluminum	11/9/1982 - 6/13/2000	µg/L	96	71	74%	3	30	11	10	7	12.9	3	30	11	10	9.15	12.05
Antimony	11/27/1995 - 6/13/2000	µg/L	44	0	0%	--	--	--	--	--	--	1 *U*	1 *U*	1	1	1	1
Arsenic	1/25/1961 - 6/4/2007	µg/L	149	59	40%	0.24	10	1	1	0.44	1	0.24	10	1	1	1	1
Barium	10/7/1977 - 6/13/2000	µg/L	111	107	96%	20	200	34	33	28.5	36	20	200	37	33	29	36.5
Beryllium	11/9/1982 - 6/13/2000	µg/L	80	1	1%	0.9	0.9	0.9	0.9	0.9	0.9	0.5 *U*	1 *U*	1	1	0.5	1
Boron	12/19/1960 - 9/27/2000	µg/L	61	14	23%	4.5	60	19	15	7	20	4 *U*	60	13	16	4.5	16
Cadmium	4/1/1975 - 6/4/2007	µg/L	144	43	30%	0.02	21	2.269	0.049	0.025	0.165	0.02	21	1	1	0.04975	1
Calcium	11/15/1951 - 9/27/2000	mg/L	359	359	100%	15	28	21	20	19	23	15	28	21	20	19	23
Chromium	1/25/1961 - 6/4/2007	µg/L	120	36	30%	0.26	30	3.32	0.78	0.3675	1.25	0.25 *U*	30	3	1	0.8	1
Cobalt	1/25/1979 - 6/13/2000	µg/L	106	1	1%	1	1	1	1	1	1	1	3 *U*	2	3	1	3
Copper	1/25/1961 - 6/4/2007	µg/L	133	105	79%	0.33	190	6.52	1.25	0.64	4	0.33	190	5	1	0.84	2.2
Iron	10/9/1974 - 9/27/2000	µg/L	127	79	62%	3	400	18	9	5	13	3	400	14	10	5	10
Lead	5/22/1985 - 6/4/2007	µg/L	119	54	45%	0.02	16	1.0823	0.0945	0.045	1	0.02	16	1	1	0.0555	1
Lithium	11/9/1982 - 9/27/2000	µg/L	104	16	15%	2	20	7	6	4.75	8.25	2	20	5	4	4	4
Magnesium	11/15/1951 - 9/27/2000	mg/L	359	359	100%	2.9	7.4	4.5	4.5	4.1	4.9	2.9	7.4	4.5	4.5	4.1	4.9
Manganese	10/9/1974 - 6/13/2000	µg/L	105	62	59%	1	80	4	2	1	3	1	80	4.1	1.6	1	3
Mercury	10/9/1974 - 9/3/1991	µg/L	63	25	40%	0.1	18	1.2	0.2	0.1	0.3	0.1	18	0.6	0.1	0.1	0.5
Molybdenum	11/9/1982 - 6/13/2000	µg/L	96	1	1%	10	10	10	10	10	10	1 *U*	10	6	10	1	10
Nickel	10/2/1981 - 6/4/2007	µg/L	141	63	45%	0.33	3	0.87	0.64	0.52	1	0.33	3	1	1	0.69	1
Potassium	12/19/1960 - 9/27/2000	mg/L	357	357	100%	0.1	1.7	0.8	0.7	0.6	0.8	0.1	1.7	0.8	0.7	0.6	0.8
Selenium	10/9/1974 - 9/27/2000	µg/L	131	0	0%	--	--	--	--	--	--	1 *U*	2 *U*	1	1	1	1
Silver	10/2/1981 - 6/4/2007	µg/L	127	5	4%	0.066	1	1	1	1	1	0.02 *U*	1	1	1	1	1
Sodium	11/1/1960 - 9/27/2000	mg/L	371	371	100%	0.9	4.5	1.8	1.8	1.5	2.1	0.9	4.5	1.8	1.8	1.5	2.1
Strontium	11/9/1982 - 9/27/2000	µg/L	107	107	100%	65	120	90	90	83.1	97.75	65	120	90	90	83.1	97.75
Vanadium	11/9/1982 - 9/27/2000	µg/L	107	0	0%	--	--	--	--	--	--	6 *U*	10 *U*	7	6	6	8
Zinc	11/21/1961 - 6/4/2007	µg/L	162	154	95%	1.1	200	16.24	4.15	2.5	20	1 *U*	200	16	4.35	2.5	20

Notes:
Data presented in the table has been evaluated over a data set which excludes values of "0" for some analytes.
mg/L = milligrams per liter
µg/L = micrograms per liter
N = number of samples

[a] Northport: Columbia River at Northport (USGS Station 12400520; Ecology's Station 61A070 at RM 735.1)

Table 5. Dissolved and Total Concentrations of Indicator Metals in Surface Water Samples from Northport (1995-2007).

			Arsenic				Cadmium				Copper				Lead				Mercury				Zinc			
Location ID	Sample Date	Sample ID	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L
61A070	1/10/1995	37006_1995110_W				30	0.088 J			3 U	1.68		14 J		0.244			20 U				0.001 U	3.7 J		7.1 J	
61A070	2/7/1995	34067_199527_W				30																				
61A070	2/7/1995	37023_199527_W								0.1 U			2.6				0.9 J								9.2 J	
61A070	3/7/1995	37042_199537_W				30	0.078 J			0.1 U	1.41		2		0.057 J		0.7 J					0.001 U	2.8 J		6.7 J	
61A070	4/4/1995	37061_199544_W			0.59 J				0.09 J				2				0.7				0.007 J				6.5 J	
61A070	5/3/1995	37080_199553_W			0.7 J				0.16 J				2.4				1.2					0.001 U			7.2 J	
61A070	6/6/1995	36261_199566_W			0.579 J					0.1 U			3.9				2.5					0.001 U			18 J	
61A070	7/11/1995	36280_1995711_W							0.14 J				2.7				1.1 J				0.001 J				21.6 J	
61A070	8/8/1995	37099_199588_W								0.1 U			1.9				0.7 J					0.001 U			48.9	
61A070	9/6/1995	36338_199596_W				1	0.083 J				1.47				0.585							0.001 U	3.7 J			
12400520	9/27/1995	1995927SW	1					1 U			1					1 U							6			
61A070	10/3/1995	37121_1995103_W					0.079			0.1 U	1.19		1.7		0.13		1.3					0.001 U	3		6.7 J	
61A070	11/7/1995	37138_1995117_W				1				0.1 U			1.4				0.6					0.001 U			8 J	
12400520	11/27/1995	19951127SW						1 U			1					1 U							4			
61A070	12/5/1995	34092_1995125_W				1	0.048				0.934				0.069								5.2			
61A070	1/9/1996	37175_199619_W				1				0.1 U			3				1.3 J				0.001	0.001			20.7	
12400520	1/16/1996	1996116SW		1 U				1 U			1					1 U							4			
61A070	2/6/1996	37188_199626_W						0.02 U			1.02				0.11							0.001 U	4.2 J			
12400520	2/14/1996	1996214SW		1 U				1 U				1 U				1 U							6			
61A070	3/5/1996	37205_199635_W			0.41					0.1 U			2.1 J				0.7								15 J	
12400520	3/6/1996	199636SW		1 U				1 U			2					1 U							2			
12400520	3/19/1996	1996319SW		1 U				1 U			2					1 U							3			
12400520	4/3/1996	199643SW		1 U				1 U			1					1 U							2			
61A070	4/10/1996	37224_1996410_W					0.058				1.16				0.092							0.001 U	3.5			
12400520	4/17/1996	1996417SW		1 U				1 U			1					1 U							2			
12400520	5/7/1996	199657SW		1 U				1 U			2					1 U							2			
61A070	5/7/1996	37243_199657_W								0.1 U			2.6				0.8								21 J	
12400520	5/22/1996	1996522SW	1					1 U			1					1 U							4			
12400520	6/3/1996	199663SW		1 U				1 U			2					1 U							6			
61A070	6/4/1996	36433_199664_W					0.03				1				0.11						0.003		2.5			
12400520	6/19/1996	1996619SW		1 U				1 U			2					1 U							3			
61A070	7/9/1996	37527_199679_W			0.48				0.53				1.4				0.8					0.001 U			5.9	
12400520	7/10/1996	1996710SW		1 U				1 U			1					1 U							8			
12400520	7/23/1996	1996723SW		1 U				1 U			2					1 U							2			
61A070	8/6/1996	34112_199686_W					0.044				0.797				0.059								2.6			
12400520	8/14/1996	1996814SW		1 U				1 U			1					1 U							5			
61A070	9/4/1996	37545_199694_W			0.26					0.1 U			1.5 J				0.8 J				0.005				7.4 J	
12400520	9/24/1996	1996924SW		1 U				1 U				1 U				1 U							3			
61A070	10/9/1996	37282_1996109_W			0.29		0.037			0.1 U	0.786		1.2 J		0.046		0.4					0.002 U	1.8 J		6.1 J	
12400520	10/22/1996	19961022SW		1 U				1 U				1 U				1 U							4			
61A070	11/6/1996	34129_1996116_W			0.29																					
61A070	11/6/1996	37301_1996116_W								0.1 U			1.1 J				0.5					0.001 U			10.1 J	
12400520	12/4/1996	1996124SW		1 U				1 U				1 U				1 U							3			
61A070	12/4/1996	37320_1996124_W			0.28		0.051			0.1 U	0.716		1.1		0.22		0.9					0.001 U	2.9		8 J	
12400520	1/13/1997	1997113SW		1 U				1 U				1 U				1 U							2			
61A070	2/5/1997	37338_199725_W			0.41			0.03 U		0.1 U	0.789		2.1		0.087		0.5					0.001 U	3.1		34 J	
61A070	3/5/1997	34153_199735_W			0.47																					
61A070	3/5/1997	37357_199735_W							0.07				1.4				0.5								6.9	
12400520	3/11/1997	1997311SW		1 U				1 U				1 U				1 U							3			
12400520	4/8/1997	199748SW		1 U				1 U			1.1					1 U							2.9			
61A070	4/9/1997	37702_199749_W			0.56		0.05			0.1 U	0.84		2		0.15		1.6					0.002 U	3.97		10.6	
12400520	4/30/1997	1997430SW		1 U				1 U			1.3					1 U							2.4			
61A070	5/7/1997	37376_199757_W			0.61					0.1 U			1.5				1.7				0.003 J				7.9 J	

Table 5. Dissolved and Total Concentrations of Indicator Metals in Surface Water Samples from Northport (1995-2007).

			Arsenic				Cadmium				Copper				Lead				Mercury				Zinc			
Location ID	Sample Date	Sample ID	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L
12400520	5/20/1997	1997520SW		1 U				1 U			1.9					1 U							2.4			
12400520	6/3/1997	199763SW		1 U				1 U			1.3					1 U							6.1			
61A070	6/4/1997	37741_199764_W			1.01		0.025		0.1		1.09		8.5		0.322		12.1				0.003		1.8		77 J	
12400520	6/17/1997	1997617SW		1 U				1 U			1.2					1 U							3.2			
12400520	6/30/1997	1997630SW		1 U				1 U			1.3					1 U							2.1			
61A070	7/9/1997	34181_199779_W			0.6																					
61A070	7/9/1997	37395_199779_W								0.1 U			1.5				0.5								5.9 J	
12400520	7/15/1997	1997715SW		1 U				1 U				1 U				1 U							1.6			
61A070	8/6/1997	36474_199786_W			0.35		0.025			0.1 U	0.721		1.1		0.05		0.4				0.002		2.56		17.5 J	
12400520	8/20/1997	1997820SW		1 U				1 U				1 U				1 U							3.2			
61A070	9/10/1997	37800_1997910_W																				0.002 U				
12400520	10/7/1997	1997107SW		1 U				1 U				1 U				1 U							1.4			
12400520	11/18/1997	19971118SW		1 U				1 U			2.2					1 U							1.4			
12400520	1/21/1998	1998121SW		1 U				1 U				1 U				1 U							2.4			
61A070	3/3/1998	98106163_199833_W			0.37		0.067			0.1 U	0.626				0.045						0.003		3.08		16.9 J	
12400520	3/4/1998	199834SW		1 U				1 U				1 U				1 U							1.7			
12400520	4/1/1998	199841SW		1 U				1 U			1.1					1 U							7.5			
12400520	4/29/1998	1998429SW		1 U				1 U				1 U				1 U							12.1			
12400520	5/27/1998	1998527SW		1 U				1 U				1 U				1 U							5.1			
12400520	6/24/1998	1998624SW		1 U				1 U				1 U				1 U							4.9			
12400520	7/21/1998	1998721SW		1 U				1 U				1 U				1 U							1.1			
12400520	9/22/1998	1998922SW		1 U				1 U				1 U				1 U							1.5			
12400520	11/23/1998	19981123SW	1																							
12400520	1/5/1999	199915SW		1 U																						
12400520	2/24/1999	1999224SW		1 U																						
12400520	4/5/1999	199945SW		1 U																						
12400520	5/5/1999	199955SW		1 U				1 U				1 U				1 U							1.8			
12400520	6/8/1999	199968SW		1 U				1 U				1 U				1 U							1.6			
12400520	6/30/1999	1999630SW		1 U				1 U				1 U				1 U							2.6			
12400520	7/21/1999	1999721SW		1 U				1 U				1 U				1 U							1.2			
12400520	8/18/1999	1999818SW		1 U																						
12400520	9/21/1999	1999921SW		1 U																						
12400520	11/17/1999	19991117SW		2 U																						
12400520	12/28/1999	19991228SW		2 U																						
12400520	2/8/2000	200028SW		2 U																						
12400520	3/15/2000	2000315SW		2 U																						
12400520	4/12/2000	2000412SW	1 J					1 U				1 U				1 U								2.1 U		
12400520	5/9/2000	200059SW		2 U				1 U				1 U				1 U								4.7 U		
12400520	6/13/2000	2000613SW		2 U				1 U				1 U				1 U								3.2 U		
12400520	8/22/2000	2000822SW		2 U																						
12400520	9/27/2000	2000927SW		2 U																						
61A070	7/9/2001	1286057_200179_W			0.44																					
61A070	8/6/2001	1368080_200186_W			0.35																					
61A070	9/10/2001	1408080_2001910_W			0.32																					
61A070	10/15/2001	1468155_20011015_W			0.53																					
61A070	11/5/2001	1498100_2001115_W			0.4																					
61A070	12/3/2001	2018080_2001123_W			0.26																					
61A070	1/14/2002	2068080_2002114_W			0.39																					
61A070	2/11/2002	2118105_2002211_W			0.86																					
61A070	3/11/2002	2158155_2002311_W			0.42																					
61A070	4/8/2002	2178180_200248_W			0.52																					
61A070	5/12/2002	2228080_2002512_W			0.44																					
61A070	6/3/2002	2268155_200263_W			0.38																					

Table 5. Dissolved and Total Concentrations of Indicator Metals in Surface Water Samples from Northport (1995-2007).

			Arsenic				Cadmium				Copper				Lead				Mercury				Zinc			
Location ID	Sample Date	Sample ID	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L	Dissolved µg/L	Dissolved, Undetect. µg/L	Total µg/L	Total, Undetect. µg/L
61A070	10/14/2002	131502_20021014_W	0.41		0.4			0.1 U		0.1 U	0.33		0.49		0.025		0.29				0.0021		1.8			5 U
61A070	12/15/2002	131727_20021215_W	0.38		0.3		0.242		0.24		0.56		0.78		0.045		0.46				0.0022		2.8			5 U
61A070	2/2/2003	131817_200322_W	0.47		0.38		0.057			0.1 U	0.62		0.74		0.031		0.17					0.002 U	4.5			5 U
61A070	4/6/2003	132021_200346_W	0.61		0.55			0.1 U		0.1 U		0.5 U	0.97 J		0.038		0.24					0.004 U	2			5 U
61A070	6/1/2003	132265_200361_W	0.58		0.58		0.021			0.1 U	0.64		4.58		0.054		1.22					0.002 U	1.9		45	
61A070	8/3/2003	132444_200383_W	0.42		0.4			0.02 U		0.1 U	0.49		1.71			0.02 U	0.37					0.002 U		1 U		5 U
61A070	10/6/2003	132608_2003106_W	0.47		0.34		0.024			0.1 U	0.56		0.62		0.021		0.2					0.002 UJ	3			5 U
61A070	12/8/2003	132787_2003128_W	0.34		0.33		0.022			0.1 U	0.56		0.6			0.02 U	0.12					0.002 U	2.3			5 U
61A070	2/9/2004	132964_200429_W	0.48		0.49		0.027			0.1 U	0.6		0.89		0.04		0.3					0.002 U	4.1		6.1	
61A070	4/12/2004	133180_2004412_W	0.41		0.48		0.027			0.1 U	0.51		1.14		0.023		0.33					0.002 U	2.6		9.4	
61A070	6/14/2004	133381_2004614_W	0.39		0.37			0.02 U		0.1 U	0.52		0.71		0.029		0.29					0.002 U	2.2		6.2	
61A070	8/2/2004	133513_200482_W	0.39		0.38			0.02 U		0.1 U	0.46		0.58		0.02		0.21					0.002 U	1.7			5 U
61A070	10/5/2004	133742_2004105_W	0.52		0.62			0.02 U		0.1 U	0.52		0.54		0.02		0.18 J					0.002 U	3.3			5 U
61A070	12/13/2004	133949_20041213_W	0.38		0.39 J		0.022			0.1 U	0.44		0.84 J			0.02 U	0.23					0.002 U	3.5			5 U
61A070	2/8/2005	134150_200528_W	0.45		0.39		0.024			0.1 U	0.44		0.65			0.02 U	0.13					0.002 U	2.5			5 U
61A070	4/5/2005	134304_200545_W	0.44		0.45 J		0.023			0.1 U	0.45		0.73			0.02 U	0.28				0.0022		2.5			5 U
61A070	6/7/2005	134560_200567_W	0.48		0.53			0.02 U		0.1 U	0.48		0.87 J			0.02 U	0.34 J					0.002 U	2.4			5 U
61A070	8/2/2005	134740_200582_W	0.33		0.27			0.02 U		0.1 U	0.46		0.64			0.02 U	0.22					0.002 U	1.4			5 U
61A070	10/4/2005	134956_2005104_W	0.46		0.47			0.02 U		0.1 U	0.51		0.6		0.021		0.21					0.002 U	1.8			5 U
61A070	12/6/2005	135222_2005126_W	0.37		0.36			0.02 U		0.1 U	0.48		0.63		0.04		1.96					0.002 U	1.6			5 U
61A070	2/7/2006	135406_200627_W	0.59		0.51		0.027			0.1 U	0.59		0.72		0.069		0.21					0.002 U	2.3			5 U
61A070	4/11/2006	135621_2006411_W	0.55		0.46		0.031			0.1 U	0.56		0.88		0.045		0.38					0.002 U	3			5 U
61A070	6/6/2006	135834_200666_W	0.48		0.49			0.02 U		0.1 U	0.9		0.96			0.02 U	0.58				0.002		7.4			5 U
61A070	8/8/2006	136043_200688_W	0.24		0.19			0.02 U		0.1 U	0.45		0.6			0.02 U	0.19					0.002 U	2			5 U
61A070	10/3/2006	136258_2006103_W	0.35		0.35		0.02			0.1 U	0.47		0.54			0.02 U	0.23					0.002 U	1.4			5 U
61A070	12/5/2006	136491_2006125_W	0.36		0.41		0.021			0.1 U	0.55		0.57		0.033		0.19					0.002 U	3.3			5 U
61A070	2/13/2007	136818_2007213_W	0.34		0.3		0.022			0.1 U	0.48		0.91			0.02 U	0.32					0.002 U	3.9		6.6	
61A070	4/3/2007	136990_200743_W	0.52		0.46			0.02 U		0.1 U	0.55		0.82		0.062		0.38					0.002 U	2.1			5 U
61A070	6/4/2007	137256_200764_W	0.44		0.36		0.024			0.1 U	1.25		1		0.11		0.8					0.002 U	17			5 U

Notes:

Location ID 61A070 denotes data from Ecology monitoring station at Northport; Location ID 12400520 denotes data from USGS monitoring station at Northport.

J = Analyte was detected below the sample minimum reporting limit, the value shown is estimated.

U = Undetected at the detection limit value shown.

µg/L = micrograms per liter

Table 6. LRFEP Summary Statistics for Detected Metals Concentrations (µg/L).[a]

				Detected Results						Detected and Undetected Results[b]				
Analyte	N	N Detected	FOD	Min	Max	Mean	Median	SD	CV	Min	Max	Mean	Median	SD
Aluminum	608	243 [c]	40%	na	na	na	na	na	na	5.0	6,000	69	30.0	261
Antimony	520	0 [c]	0%	na	na	na	na	na	na	10	25	23	25	4.3
Arsenic	608	15	2.5%	1	98	45	57	33	74	0.5	98	22	25	10
Barium	520	520 [c]	100%	na	na	na	na	na	na	15	152	31	29	12
Beryllium	520	0 [c]	0%	na	na	na	na	na	na	0.5	2.0	0.5	0.5	0.1
Cadmium	608	8	1.3%	5	7	5.9	5.5	1	17	2.0	7.0	2.6	2.5	0.6
Calcium	608	608 [c]	100%	na	na	na	na	na	na	6,730	33,800	17,862	18,000	2,566
Chromium	520	0 [c]	0%	na	na	na	na	na	na	2.0	3.5	3.3	3.5	0.5
Cobalt	520	0 [c]	0%	na	na	na	na	na	na	2.0	7.0	3.3	3.5	0.5
Copper	520	14	2.7%	4	28	9.1	8	6.2	68	2.0	28	3.5	3.5	1.4
Iron	608	578 [c]	95.0%	na	na	na	na	na	na	5.0	1,260	57	34	92
Lead	608	402	66.1%	1	182	5.6	4	11	188	0.5	182	3.9	2.0	8.8
Magnesium	608	608 [c]	100%	na	na	na	na	na	na	2,230	8,860	4,376	4,200	873
Manganese	608	407 [c]	67.0%	na	na	na	na	na	na	0.5	88	5.8	4.0	8.1
Mercury	545	1	0.2%	1.2	1.2	1.2	1.2	--	--	0.1	1.2	0.1	0.1	0.0
Nickel	520	5 [c]	1.0%	na	na	na	na	na	na	5.0	29	7.4	7.5	1.9
Potassium	608	225 [c]	37.0%	na	na	na	na	na	na	425	1,860	631	450	306
Selenium	519	5 [c]	1.0%	na	na	na	na	na	na	25	98	39	40	6.6
Silica	608	608 [c]	100%	na	na	na	na	na	na	1,500	8,530	2,841	2,550	1,024
Silver	520	0 [c]	0%	na	na	na	na	na	na	2.5	5.0	4.7	5.0	0.8
Sodium	608	608 [c]	100%	na	na	na	na	na	na	1,070	5,730	2,083	1,945	658
Zinc	608	92	15.1%	5	84	22.5	14.5	16.1	72	2.5	84	7.9	5.0	9.1

Notes:
CV = coefficient of variation
FOD = frequency of detection
µg/L = micrograms per liter
N = number of samples
na = Data not provided in Scofield and Pavlik-Kunkel (2007).
SD = standard deviation

[a] Summary statistics shown were compiled from statistics provided in Scofield and Pavlik-Kunkel (2007). Frequency of detection was calculated based on statistics provided. For this table, values < 10 were rounded to the nearest one-tenth (i.e., one decimal place), and values >10 were rounded to the nearest whole value (i.e., no decimal places).
[b] Statistics provided include estimated concentrations which were calculated by dividing the minimum reporting limit (MRL) in half (Scofield and Pavlik-Kunkel 2007).
[c] Approximate; N detected was calculated based on information on the number of results below the MRLs, provided in Scofield and Pavlik-Kunkel (2007).

Table 7. Summary Statistics for Organic Analytical Results from USGS Sampling at Northport[a] (1995-2000).

						Detected Results						Detected and Undetected Results					
Analyte	Sample Date Range	Units	N	N Detected	Frequency of Detection	Min	Max	Mean	Median	25th Percentile	75th Percentile	Min	Max	Mean	Median	25th Percentile	75th Percentile
Herbicides																	
Acetochlor	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.004 U	0.002	0.002	0.002	0.002
Alachlor	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.002 U	0.002	0.002	0.002	0.002
Benfluralin	11/27/1995 - 9/27/2000	ug/L	55	1	2%	0.004	0.004	0.004	0.004	0.004	0.004	0.002 U	0.01 U	0.002	0.002	0.002	0.002
Butylate	11/27/1995 - 9/27/2000	ug/L	55	1	2%	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Cyanazine	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.004 U	0.018 U	0.004	0.004	0.004	0.004
Dimethyl tetrachloroterephthalate	1/16/1996 - 9/27/2000	ug/L	54	6	11%	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.003 U	0.002	0.002	0.002	0.002
Ethalfluralin	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.004 U	0.009 U	0.004	0.004	0.004	0.004
Metolachlor	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.013 U	0.002	0.002	0.002	0.002
Metribuzin	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.004 U	0.006 U	0.004	0.004	0.004	0.004
Napropamide	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.003 U	0.007 U	0.003	0.003	0.003	0.003
Pebulate	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.004 U	0.004	0.004	0.004	0.004
Pendimethalin	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.004 U	0.01 U	0.004	0.004	0.004	0.004
Prometon	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.01 U	0.02 U	0.02	0.02	0.02	0.02
Simazine	11/27/1995 - 9/27/2000	ug/L	55	2	4%	0.002	0.003	0.0025	0.0025	0.00225	0.00275	0.002	0.011 U	0.005	0.005	0.005	0.005
Thiobencarb	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.005 U	0.002	0.002	0.002	0.002
Triallate	11/27/1995 - 9/27/2000	ug/L	55	2	4%	0.002	0.002	0.002	0.002	0.002	0.002	0.001 U	0.002	0.001	0.001	0.001	0.001
Trifluralin	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.009 U	0.002	0.002	0.002	0.002
Pesticides																	
2,6-Diethylaniline	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.003 U	0.003	0.003	0.003	0.003
2-Chloro-4-isopropylamino-6-amino-s-triazine	11/27/1995 - 9/27/2000	ug/L	55	1	2%	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.006 U	0.002	0.002	0.002	0.002
4,4'-DDE	11/27/1995 - 9/27/2000	ug/L	55	6	11%	0.001	0.002	0.002	0.002	0.00125	0.002	0.001	0.006 U	0.005	0.006	0.006	0.006
alpha-HCH	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.005 U	0.002	0.002	0.002	0.002
Atrazine	11/27/1995 - 9/27/2000	ug/L	55	6	11%	0.002	0.004	0.003	0.002	0.002	0.00275	0.001 U	0.008 U	0.001	0.001	0.001	0.001
Azinphos-methyl	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.001 U	0.05 U	0.002	0.001	0.001	0.001
Carbaryl	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.003 U	0.041 U	0.004	0.003	0.003	0.003
Carbofuran	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.003 U	0.02 U	0.003	0.003	0.003	0.003
Chlorpyrifos	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.004 U	0.005 U	0.004	0.004	0.004	0.004
cis-Permethrin	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.005 U	0.006 U	0.005	0.005	0.005	0.005
Diazinon	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.005 U	0.002	0.002	0.002	0.002
Dieldrin	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.001 U	0.005 U	0.001	0.001	0.001	0.001
Disulfoton	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.02 U	0.02 U	0.02	0.02	0.02	0.02
Ethoprop	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.003 U	0.005 U	0.003	0.003	0.003	0.003
Ethyl di-n-prophylthiolcarbamate	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.002 U	0.002	0.002	0.002	0.002
Fonofos	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.003 U	0.003 U	0.003	0.003	0.003	0.003
gamma-BHC (Lindane)	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.004 U	0.004 U	0.004	0.004	0.004	0.004
Linuron	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.035 U	0.003	0.002	0.002	0.002
Malathion	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.005 U	0.027 U	0.005	0.005	0.005	0.005
Methyl parathion	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.006 U	0.006 U	0.006	0.006	0.006	0.006
Molinate	11/27/1995 - 9/27/2000	ug/L	55	1	2%	0.011	0.011	0.011	0.011	0.011	0.011	0.002 U	0.011	0.004	0.004	0.004	0.004
Parathion	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.004 U	0.007 U	0.004	0.004	0.004	0.004
Phorate	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.002 U	0.011 U	0.002	0.002	0.002	0.002
Propachlor	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.007 U	0.01 U	0.007	0.007	0.007	0.007
Propanil	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.004 U	0.011 U	0.004	0.004	0.004	0.004
Propargite	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.01 U	0.05 U	0.01	0.01	0.01	0.01

Table 7. Summary Statistics for Organic Analytical Results from USGS Sampling at Northport[a] (1995-2000).

						Detected Results						Detected and Undetected Results					
Analyte	Sample Date Range	Units	N	N Detected	Frequency of Detection	Min	Max	Mean	Median	25th Percentile	75th Percentile	Min	Max	Mean	Median	25th Percentile	75th Percentile
Propyzamide	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.003 *U*	0.004 *U*	0.003	0.003	0.003	0.003
Tebuthiuron	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.01 *U*	0.02 *U*	0.01	0.01	0.01	0.01
Terbacil	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.007 *U*	0.034 *U*	0.007	0.007	0.007	0.007
Terbufos	11/27/1995 - 9/27/2000	ug/L	55	0	0%	--	--	--	--	--	--	0.01 *U*	0.02 *U*	0.01	0.01	0.01	0.01

Notes:
Data presented in the table has been evaluated over a dataset which excludes 0 values for some analytes.
-- = not applicable
µg/L = micrograms per liter
N = number of samples
U = Compound not detected at or above the reported concentration.

[a] Northport: Columbia River at Northport (USGS Station 12400520).

Table 8. Summary Statistics for Conventional Parameters Analyzed within the Study Area.[a]

	Columbia River Stations					
	Columbia River at Northport	FDR Reservoir at Kettle Falls[b]	Spokane River at Mouth	FDR Reservoir at Lincoln Boat Ramp[b]	FDR Reservoir at Keller Ferry[b]	FDR Reservoir at Log Boom[b]
Station ID:	12400520 (USGS) 61A070 (ECY)	FDR005 (USBR)	54A050 (ECY)	FDR008 (USBR)	FDR008 (USBR)	FDR010 (USBR)
Alkalinity (mg/L as $CaCO_3$)						
Date Range	1970-1980	-	-	-	-	-
Count	108	-	-	-	-	-
Minimum	39.0	-	-	-	-	-
Maximum	75.0	-	-	-	-	-
Median	60.0	-	-	-	-	-
25th Percentile	54.75	-	-	-	-	-
75th Percentile	65	-	-	-	-	-
Calcium (Dissolved, mg/L)						
Date Range	1951-2000	-	-	-	-	-
Count	359	-	-	-	-	-
Number of detected results	359	-	-	-	-	-
Minimum	15	-	-	-	-	-
Maximum	28	-	-	-	-	-
Median	20.0	-	-	-	-	-
25th Percentile	19.0	-	-	-	-	-
75th Percentile	23.0	-	-	-	-	-
Chloride (Dissolved, mg/L)						
Date Range	1951-2000	-	-	-	-	-
Count	351	-	-	-	-	-
Number of detected results	350	-	-	-	-	-
Minimum	0.1	-	-	-	-	-
Maximum	2.5	-	-	-	-	-
Median	0.8	-	-	-	-	-
25th Percentile	0.6	-	-	-	-	-
75th Percentile	1	-	-	-	-	-
Conductivity (µS/cm)						
Date Range	1951-2007	2002-2006	1990-1994	2002-2006	2002-2006	2002-2006

Table 8. Summary Statistics for Conventional Parameters Analyzed within the Study Area.[a]

	Columbia River Stations					
	Columbia River at Northport	FDR Reservoir at Kettle Falls[b]	Spokane River at Mouth	FDR Reservoir at Lincoln Boat Ramp[b]	FDR Reservoir at Keller Ferry[b]	FDR Reservoir at Log Boom[b]
Station ID:	12400520 (USGS) 61A070 (ECY)	FDR005 (USBR)	54A050 (ECY)	FDR008 (USBR)	FDR008 (USBR)	FDR010 (USBR)
Count	1192	371	45	572	590	434
Minimum	13	102	65	110	112	113
Maximum	257	138	203	138	139	139
Median	144	125	129	123	123	126
25th Percentile	134	119	102	120	120	120
75th Percentile	158	130	148	128	128	130
Dissolved Organic Carbon (DOC, mg/L)						
Date Range	1978-2000	-	-	-	-	-
Count	66	-	-	-	-	-
Minimum	0.9	-	-	-	-	-
Maximum	10.0	-	-	-	-	-
Median	1.4	-	-	-	-	-
25th Percentile	1.1	-	-	-	-	-
75th Percentile	1.6	-	-	-	-	-
Dissolved Oxygen (DO, mg/L)						
Date Range	1962-2007	2002-2006	1990-1994	2002-2006	2002-2006	2002-2006
Count	541	371	45	572	590	434
Minimum	5.0	8.4	7.8	5.5	5.6	6.1
Maximum	14.8	12.3	14.1	12	11.6	11.7
Median	11.8	9.3	10.2	8.6	8.9	8.5
25th Percentile	10.6	8.9	8.9	7.9	7.8	7.7
75th Percentile	12.7	10.4	12.0	9.8	9.6	9.2
Fluoride, dissolved (mg/L)						
Date Range	1952-2000	-	-	-	-	-
Count	339	-	-	-	-	-
Number of detected results	272	-	-	-	-	-
Minimum	0.1 U	-	-	-	-	-
Maximum	0.6	-	-	-	-	-

Table 8. Summary Statistics for Conventional Parameters Analyzed within the Study Area.[a]

	Columbia River Stations					
	Columbia River at Northport	FDR Reservoir at Kettle Falls[b]	Spokane River at Mouth	FDR Reservoir at Lincoln Boat Ramp[b]	FDR Reservoir at Keller Ferry[b]	FDR Reservoir at Log Boom[b]
Station ID:	12400520 (USGS) 61A070 (ECY)	FDR005 (USBR)	54A050 (ECY)	FDR008 (USBR)	FDR008 (USBR)	FDR010 (USBR)
Median	0.1	-	-	-	-	-
25th Percentile	0.1	-	-	-	-	-
75th Percentile	0.2	-	-	-	-	-
Hardness (mg/L as $CaCO_3$)						
Date Range	1951-2007	-	1990-1991	-	-	-
Count	861	-	6	-	-	-
Minimum	24.0	-	29	-	-	-
Maximum	130	-	74	-	-	-
Median	71.0	-	46	-	-	-
25th Percentile	65.4	-	37	-	-	-
75th Percentile	78.0	-	49.8	-	-	-
Magnesium (dissolved, mg/L)						
Date Range	1951-2000	-	-	-	-	-
Count	359	-	-	-	-	-
Number of detected results	359	-	-	-	-	-
Minimum	2.9	-	-	-	-	-
Maximum	7.4	-	-	-	-	-
Median	4.5	-	-	-	-	-
25th Percentile	4.1	-	-	-	-	-
75th Percentile	4.9	-	-	-	-	-
ORP (mV)						
Date Range	-	2002-2006	-	2002-2006	2002-2006	2002-2006
Count	-	353	-	550	565	394
Minimum	-	-144	-	-35	34	-91
Maximum	-	322	-	381	398	290
Median	-	216	-	219	231	224
25th Percentile	-	125	-	116	144	134
75th Percentile	-	255	-	248	254	257

Table 8. Summary Statistics for Conventional Parameters Analyzed within the Study Area.[a]

	Columbia River Stations					
	Columbia River at Northport	FDR Reservoir at Kettle Falls[b]	Spokane River at Mouth	FDR Reservoir at Lincoln Boat Ramp[b]	FDR Reservoir at Keller Ferry[b]	FDR Reservoir at Log Boom[b]
Station ID:	12400520 (USGS) 61A070 (ECY)	FDR005 (USBR)	54A050 (ECY)	FDR008 (USBR)	FDR008 (USBR)	FDR010 (USBR)
pH (standard units)						
Date Range	1948-2007	2002-2006	1990-1994	2002-2006	2002-2006	2002-2006
Count	1106	371	45	572	590	434
Minimum	6.8	7.3	7.3	7.3	7.0	7.2
Maximum	13.0	8.7	8.7	8.5	8.6	8.8
Median	7.8	8.2	8.0	8.0	7.9	8.0
25th Percentile	7.6	8.0	7.8	7.8	7.8	7.9
75th Percentile	8.0	8.3	8.3	8.1	8.1	8.2
Sodium (Dissolved, mg/L)						
Date Range	1960-2000	-	-	-	-	-
Count	371	-	-	-	-	-
Number of detected results	371	-	-	-	-	-
Minimum	0.9	-	-	-	-	-
Maximum	4.5	-	-	-	-	-
Median	1.8	-	-	-	-	-
25th Percentile	1.5	-	-	-	-	-
75th Percentile	2.1	-	-	-	-	-
Sulfate (Dissolved, mg/L)						
Date Range	1951-2000	-	-	-	-	-
Count	361	-	-	-	-	-
Number of detected results	360	-	-	-	-	-
Minimum	1.6	-	-	-	-	-
Maximum	23.0	-	-	-	-	-
Median	12.0	-	-	-	-	-
25th Percentile	9.1	-	-	-	-	-
75th Percentile	15.0	-	-	-	-	-
Temperature (° Celsius)						

Table 8. Summary Statistics for Conventional Parameters Analyzed within the Study Area.[a]

	Columbia River Stations					
	Columbia River at Northport	FDR Reservoir at Kettle Falls[b]	Spokane River at Mouth	FDR Reservoir at Lincoln Boat Ramp[b]	FDR Reservoir at Keller Ferry[b]	FDR Reservoir at Log Boom[b]
Station ID:	12400520 (USGS) 61A070 (ECY)	FDR005 (USBR)	54A050 (ECY)	FDR008 (USBR)	FDR008 (USBR)	FDR010 (USBR)
Date Range	1967-2007	2002-2006	1990-1994	2002-2006	2002-2006	2002-2006
Count	658	371	45	572	590	434
Minimum	0.0	8.2	0.9	6.7	6.6	7
Maximum	20.1	20.6	25.3	23.8	24.5	24.7
Median	8.7	16	11.6	16.2	16.1	17.7
25th Percentile	4.3	12.2	5.4	13.8	12.9	14.9
75th Percentile	14.6	18.4	19.4	18.7	18.9	19.6
Total Dissolved Solids (TDS, mg/L)						
Date Range	1960-2000	-	-	-	-	-
Count	347	-	-	-	-	-
Minimum	61.0	-	-	-	-	-
Maximum	158.0	-	-	-	-	-
Median	84.0	-	-	-	-	-
25th Percentile	77.5	-	-	-	-	-
75th Percentile	92.0	-	-	-	-	-
Total Organic Carbon (TOC, mg/L)						
Date Range	1974-1981	-	-	-	-	-
Count	454	-	-	-	-	-
Number of detected results	435	-	-	-	-	-
Minimum	0.5	-	-	-	-	-
Maximum	6.7	-	-	-	-	-
Median	2.0	-	-	-	-	-
25th Percentile	1.4	-	-	-	-	-
75th Percentile	2.7	-	-	-	-	-
Total Suspended Solids (TSS, mg/L)						
Date Range	1974-2007	-	-	-	-	-
Count	454	-	-	-	-	-
Number of detected results	435	-	-	-	-	-

Table 8. Summary Statistics for Conventional Parameters Analyzed within the Study Area.[a]

	Columbia River Stations					
	Columbia River at Northport	FDR Reservoir at Kettle Falls[b]	Spokane River at Mouth	FDR Reservoir at Lincoln Boat Ramp[b]	FDR Reservoir at Keller Ferry[b]	FDR Reservoir at Log Boom[b]
Station ID:	12400520 (USGS) 61A070 (ECY)	FDR005 (USBR)	54A050 (ECY)	FDR008 (USBR)	FDR008 (USBR)	FDR010 (USBR)
Minimum	0.5 U	-	-	-	-	-
Maximum	43.0	-	-	-	-	-
Median	3.0	-	-	-	-	-
25th Percentile	2.0	-	-	-	-	-
75th Percentile	5.0	-	-	-	-	-
Turbidity (NTU)						
Date Range	1978-2007	-	1990-1994	-	-	-
Count	382	-	45	-	-	-
Number of detected results	371	-	41	-	-	-
Minimum	0.2	-	0.5	-	-	-
Maximum	11.0	-	11	-	-	-
Median	1.0	-	1.1	-	-	-
25th Percentile	0.6	-	0.8	-	-	-
75th Percentile	1.4	-	1.6	-	-	-

Notes:
$CaCO_3$ = calcium carbonate
mg/L = milligrams per liter
mV = millivolts
µS/cm = microsiemens per centimeter
NTU = nephelometric turbidity unit
ORP = oxidation-reduction potential
U = The analyte was not detected at or above the reported concentration.

[a] All statistical evaluations have been performed on both detected and non-detected values, and excludes values of "0" reported for some non-field measurements.
[b] Data from these stations (U.S. Bureau of Reclamation) represent vertical profile measurements.

Table 9. Temporal Variability in Concentrations of Several Water Quality Parameters at Waneta, B.C. (2000-2006).

Metric	Mean[a]	Coefficient of Variation[a], %
Barium, µg/L	20	9
Potassium, mg/L	0.62	9
Hardness, mg/L $CaCO_3$	65	8
Sodium, mg/L	1.5	18
SiO_2, mg/L	1.85	26

Source: Environment Canada (2009)

Notes:
$CaCO_3$ = calcium carbonate
mg/L = milligrams per liter
SiO_2 = silicon dioxide (silica)

[a] Statistics were calculated using all weekly data from 2000-2006.

Table 10. Regression Equations, Means, and Standard Errors (SE) for Concentrations of Some Inorganic Constituents in Surface Waters Measured in Lake Roosevelt from Evans to Grand Coulee Dam.

Regression Equation	R^2	Mean ±1 SE in UCR	Mean ±1 SE at Waneta
Barium (µg/L) = 0.0404x + 4.99	0.59	31 ± 0.7	20 ± 0.1
Hardness (mg/L) = 0.0209x + 49.48	0.34	62.8 ± 0.97	64.7 ± 0.3
Potassium (µg/L) = -0.785x + 1071.8	0.61	556 ± 13	616 ± 5
SiO_2 (mg/L) = -4.0552x + 5181	0.85	2.55 ± 0.06	1.85 ± 0.04
Sodium (mg/L) = -1.8754x + 3128.7	0.89	1.91 ± .03	1.52 ± 0.025

Source: Scofield and Pavlik-Kunkel (2007), Environment Canada (2009)

Notes:
x = distance from Grand Coulee Dam
mg/L = milligrams per liter
µg/L = micrograms per liter
R^2 = coefficient of determination
SiO_2 = silicon dioxide (silica)

Table 11. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
Nutrients											
Ammonia	2070	b,c,d,e	Dissolved	91	17	19%	0.02	0.00001	0	0.01	0
Cyanide	5.2	b,c,d,e	Dissolved	7	0	0%	-	-	-	0.018	0
Nitrite-Nitrate	no SEV		Dissolved	84	84	100%	0.137	-	-	n/a	-
Phosphorus	no SEV		Dissolved	93	52	56%	0.05	-	-	0.01	-
Metals/Metalloids											
Aluminum	87	b,d,e	Dissolved	5	2	40%	11.5	0.1	0	19	0
Antimony	no SEV		Dissolved	5	1	20%	0.46	-	-	1	-
Arsenic	150	b,d,e	Dissolved	35	27	77%	1	0.01	0	2	0
Arsenic	5	f	Total Recoverable	38	38	100%	0.86	0.2	0	n/a	n/a
Barium	no SEV		Dissolved	5	5	100%	37	-	-	n/a	-
Beryllium	no SEV		Dissolved	5	0	0%	-	-	-	1	-
Bismuth	no SEV		Dissolved	2	0	0%	-	-	-	0.2	-
Boron	no SEV		Dissolved	7	1	14%	8.5	-	-	16	-
Cadmium	0.19[a]	b,d	Dissolved	31	15	48%	0.24	1.4	1	1	3
Cadmium	0.02	f	Total Recoverable	26	1	4%	0.24	12	1	1	25
Calcium	no SEV		Dissolved	9	9	100%	19.8	-	-	n/a	-
Cerium	no SEV		Dissolved	2	0	0%	-	-	-	0.05	-
Cesium	no SEV		Dissolved	2	0	0%	-	-	-	0.02	-
Chloride	230000	b,c,d,e	Dissolved	7	7	100%	0.99	0.004	-	n/a	n/a
Chromium	53[a]	b,d,e	Dissolved	31	16	52%	0.56	0.01	0	5	0
Chromium	8.9	f	Total Recoverable	26	1	4%	0.83	0.1	0	0.5	0
Cobalt	no SEV		Dissolved	5	1	20%	0.11	-	-	1	-
Copper	6.4[a]	b,d,e	Dissolved	31	27	87%	0.99	0.2	0	1	0
Copper	2[a]	f	Total Recoverable	26	26	100%	4.58	1.4	1	n/a	n/a
Dysprosium	no SEV		Dissolved	2	0	0%	-	-	-	0.04	-
Erbium	no SEV		Dissolved	2	1	50%	0.03	-	-	0.025	-
Europium	no SEV		Dissolved	2	0	0%	-	-	-	0.025	-
Fluoride	no SEV		Dissolved	7	0	0%	-	-	-	0.1	-
Gadolinium	no SEV		Dissolved	2	0	0%	-	-	-	0.025	-
Gallium	no SEV		Dissolved	2	0	0%	-	-	-	0.05	-
Germanium	no SEV		Dissolved	2	0	0%	-	-	-	0.25	-
Gold	no SEV		Dissolved	0	-	-	-	-	-	-	-
Holmium	no SEV		Dissolved	2	0	0%	-	-	-	0.25	-

Table 11. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
Indium	no SEV		Dissolved	0	-	-	-	-	-	-	-
Iron	1000	b,d,e	Dissolved	9	3	33%	10	0.01	0	250	0
Lanthanum	no SEV		Dissolved	2	0	0%	-	-	-	0.1	-
Lead	1.6[a]	b,c,d,e	Dissolved	31	16	52%	0.07	0.04	0	1	0
Lead	2[a]	f	Total Recoverable	26	26	100%	1.96	1.1	1	n/a	n/a
Lithium	no SEV		Dissolved	9	2	22%	2	-	-	4.5	-
Lutetium	no SEV		Dissolved	2	0	0%	-	-	-	0.5	-
Magnesium	no SEV		Dissolved	9	9	100%	4.71	-	-	n/a	-
Manganese	no SEV		Dissolved	5	2	40%	1.9	-	-	5	-
Mercury	0.012	c,e	Total	26	4	15%	0.0022	0.2	0	0.004	0
Mercury	0.03	f	Total Recoverable	26	4	15%	0.0022	0.1	0	0.004	0
Molybdenum	no SEV		Dissolved	5	0	0%	-	-	-	2	-
Neodymium	no SEV		Dissolved	2	0	0%	-	-	-	0.05	-
Nickel	37[a]	b,d,e	Dissolved	38	28	74%	1.63	0.05	0	1	0
Nickel	65[a]	f	Total Recoverable	26	26	100%	0.95	0.03	0	n/a	n/a
Niobium	no SEV		Dissolved	2	0	0%	-	-	-	1	-
Potassium	no SEV		Dissolved	9	9	100%	0.8	-	-	n/a	-
Praseodymium	no SEV		Dissolved	2	0	0%	-	-	-	0.05	-
Rubidium	no SEV		Dissolved	2	2	100%	0.86	-	-	n/a	-
Samarium	no SEV		Dissolved	2	0	0%	-	-	-	0.09	-
Scandium	no SEV		Dissolved	2	0	0%	-	-	-	3	-
Selenium	5	b,c,d,e	Dissolved	9	0	0%	-	-	-	5	2
Silicon (Silica)	no SEV		Dissolved	9	9	100%	6.81	-	-	n/a	-
Silver	1.6[a,g]	b,d	Dissolved	31	1	3%	0.066	0.04	0	15	2
Silver	0.1	f	Total Recoverable	26	0	0%	-	-	-	0.1	26
Sodium	no SEV		Dissolved	9	9	100%	2.19	-	-	n/a	-
Strontium	no SEV		Dissolved	9	9	100%	101	-	-	n/a	-
Sulfur (Sulfate)	no SEV		Dissolved	9	9	100%	33	-	-	n/a	-
Tantalum	no SEV		Dissolved	2	0	0%	-	-	-	0.1	-
Tellurium	no SEV		Dissolved	0	-	-	-	-	-	-	-
Terbium	no SEV		Dissolved	2	0	0%	-	-	-	0.1	-
Thallium	no SEV		Dissolved	2	0	0%	-	-	-	0.2	-
Thorium	no SEV		Dissolved	2	0	0%	-	-	-	1	-
Thulium	no SEV		Dissolved	2	0	0%	-	-	-	0.045	-

Table 11. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
Tin	no SEV		Dissolved	0	-	-	-	-	-	-	-
Titanium	no SEV		Dissolved	2	0	0%	-	-	-	2.5	-
Tungsten	no SEV		Dissolved	2	0	0%	-	-	-	0.5	-
Uranium	no SEV		Dissolved	5	0	0%	-	-	-	1	-
Vanadium	no SEV		Dissolved	9	0	0%	-	-	-	10	-
Ytterbium	no SEV		Dissolved	2	0	0%	-	-	-	0.025	-
Yttrium	no SEV		Dissolved	2	0	0%	-	-	-	0.05	-
Zinc	74[a]	c,e	Dissolved	31	25	81%	7.4	0.1	0	4.7	0
Zinc	30	f	Total Recoverable	26	4	15%	45	1.5	1	5	0
Zirconium	no SEV		Dissolved	2	0	0%	-	-	-	1	-
Dioxins/Furans											
1,2,3,4,6,7,8-HpCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,4,6,7,8-HpCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,4,7,8,9-HpCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,4,7,8-HxCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,4,7,8-HxCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,6,7,8-HxCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,6,7,8-HxCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,7,8,9-HxCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,7,8,9-HxCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,7,8-PCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,3,7,8-PCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,3,4,6,7,8-HxCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,3,4,7,8-PCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,3,7,8-TCDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,3,7,8-TCDF	no SEV		Dissolved	0	-	-	-	-	-	-	-
Octachlorodibenzodioxin	no SEV		Dissolved	0	-	-	-	-	-	-	-
Octachlorodibenzofuran	no SEV		Dissolved	0	-	-	-	-	-	-	-
PAHs											
2-Methylnaphthalene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Acenaphthene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Acenaphthylene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Anthracene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzo(a)anthracene	no SEV		Dissolved	0	-	-	-	-	-	-	-

Table 11. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

				Surface Water Screening Results for Aquatic Life (µg/L)							
Analyte	SEV (µg/L)	Source of SEV	Measure	N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
Benzo(a)pyrene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzo(b)fluoranthene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzo(ghi)perylene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzo(k)fluoranthene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Chrysene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Dibenzo(a,h)anthracene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Fluoranthene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Fluorene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Indeno[1,2,3-cd]pyrene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Naphthalene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Phenanthrene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Pyrene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Total PAHs	no SEV		Dissolved	0	-	-	-	-	-	-	-
PCBs											
Aroclor 1016	no SEV		Dissolved	0	-	-	-	-	-	-	-
Aroclor 1221	no SEV		Dissolved	0	-	-	-	-	-	-	-
Aroclor 1232	no SEV		Dissolved	0	-	-	-	-	-	-	-
Aroclor 1242	no SEV		Dissolved	0	-	-	-	-	-	-	-
Aroclor 1248	no SEV		Dissolved	0	-	-	-	-	-	-	-
Aroclor 1254	no SEV		Dissolved	0	-	-	-	-	-	-	-
Aroclor 1260	no SEV		Dissolved	0	-	-	-	-	-	-	-
Total PCBs	0.014	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
PBDEs											
Total PBDEs	no SEV		Dissolved	0	-	-	-	-	-	-	-
Pesticides											
2,4'-DDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4'-DDE	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4'-DDT	no SEV		Dissolved	0	-	-	-	-	-	-	-
4,4'-DDD	no SEV		Dissolved	0	-	-	-	-	-	-	-
4,4'-DDE	no SEV		Dissolved	7	2	29%	0.002	-	-	0.006	-
4,4'-DDT	no SEV		Dissolved	0	-	-	-	-	-	-	-
Total DDx	0.001	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
Alachlor	no SEV		Dissolved	7	0	0%	-	-	-	0.002	-
Aldrin	0.0019	c,e	Dissolved	0	-	-	-	-	-	-	-
Atrazine	no SEV		Dissolved	7	0	0%	-	-	-	0.008	-

Table 11. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
alpha-BHC	no SEV		Dissolved	7	0	0%	-	-	-	0.005	-
beta-BHC	no SEV		Dissolved	0	-	-	-	-	-	-	-
gamma-BHC (Lindane)	0.08	c,e	Dissolved	7	0	0%	-	-	-	0.004	0
alpha-Chlordane	0.0043	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
gamma-Chlordane	no SEV		Dissolved	0	-	-	-	-	-	-	-
cis-Nonachlor	no SEV		Dissolved	0	-	-	-	-	-	-	-
trans-Nonachlor	no SEV		Dissolved	0	-	-	-	-	-	-	-
Oxychlordane	no SEV		Dissolved	0	-	-	-	-	-	-	-
Total Chlordane	no SEV		Dissolved	0	-	-	-	-	-	-	-
Dieldrin	0.0019	c,e	Dissolved	7	0	0%	-	-	-	0.005	1
Endosulfan I	0.056	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
Endosulfan II	0.056	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
Endrin	0.0023	c,e	Dissolved	0	-	-	-	-	-	-	-
Endrin aldehyde	no SEV		Dissolved	0	-	-	-	-	-	-	-
Endrin ketone	no SEV		Dissolved	0	-	-	-	-	-	-	-
Endosulfan sulfate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Heptachlor	0.0038	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
Heptachlor epoxide	0.0038	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
Hexachlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Hexachlorobutadiene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Methoxychlor	0.03	b,d,e	Dissolved	0	-	-	-	-	-	-	-
Toxaphene	0.0002	b,c,d,e	Dissolved	0	-	-	-	-	-	-	-
SVOCs											
1,1'-Biphenyl	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2,4-Trichlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,2-Dichlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,3-Dichlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
1,4-Dichlorobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,2'-oxybis(1-Chloropropane)	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4,5-Trichlorophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4,6-Trichlorophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4-Dichlorophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4-Dimethylphenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4-Dinitrophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2,4-Dinitrotoluene	no SEV		Dissolved	0	-	-	-	-	-	-	-

Table 11. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
2,6-Dinitrotoluene	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Chloronaphthalene	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Chlorophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Methylphenol (o-cresol)	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Nitroaniline	no SEV		Dissolved	0	-	-	-	-	-	-	-
2-Nitrophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
3,3'-Dichlorobenzidine	no SEV		Dissolved	0	-	-	-	-	-	-	-
3-Nitroaniline	no SEV		Dissolved	0	-	-	-	-	-	-	-
4,6-Dinitro-2-methylphenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Bromophenyl-phenylether	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Chloro-3-methylphenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Chloroaniline	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Chlorophenyl-phenyl ether	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Methylphenol (p-cresol)	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Nitroaniline	no SEV		Dissolved	0	-	-	-	-	-	-	-
4-Nitrophenol	no SEV		Dissolved	0	-	-	-	-	-	-	-
Acetophenone	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzaldehyde	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzoic acid	no SEV		Dissolved	0	-	-	-	-	-	-	-
Benzyl alcohol	no SEV		Dissolved	0	-	-	-	-	-	-	-
Bis(2-chloroethoxy)methane	no SEV		Dissolved	0	-	-	-	-	-	-	-
Bis(2-chloroethyl)ether	no SEV		Dissolved	0	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Butyl benzyl phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Caprolactam	no SEV		Dissolved	0	-	-	-	-	-	-	-
Dibenzofuran	no SEV		Dissolved	0	-	-	-	-	-	-	-
Diethyl phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Dimethyl phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Di-n-butyl phthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Di-n-octylphthalate	no SEV		Dissolved	0	-	-	-	-	-	-	-
Hexachlorocyclopentadiene	no SEV		Dissolved	0	-	-	-	-	-	-	-
Hexachloroethane	no SEV		Dissolved	0	-	-	-	-	-	-	-
Isophorone	no SEV		Dissolved	0	-	-	-	-	-	-	-
Nitrobenzene	no SEV		Dissolved	0	-	-	-	-	-	-	-
N-Nitrosodi-n-propylamine	no SEV		Dissolved	0	-	-	-	-	-	-	-

Table 11. Summary of Screening Results for Surface Water Collected in the UCR between 2000 and 2006.

Analyte	SEV (µg/L)	Source of SEV	Measure	Surface Water Screening Results for Aquatic Life (µg/L)							
				N	# DT	FOD	Max Msd	Max Msd HQ	#Msd>SEV	Max DL	#DL>SEV
N-Nitrosodiphenylamine	no SEV		Dissolved	0	-	-	-	-	-	-	-
Pentachlorophenol	17.5	c,e	Dissolved	0	-	-	-	-	-	-	-
Phenol	no SEV		Dissolved	0	-	-	-	-	-	-	-

Notes:
Shaded values are greater than or equal to the SEV.
DT = number of detected samples.
#DL>SEV = number of detection limits from non-detected samples greater than the SEV.
#Msd>SEV = number of measured samples greater than the SEV.
FOD = frequency of detection
Max DL = maximum detection limit
Max Msd = maximum measured concentration
Max Msd HQ = ratio of the maximum measured value to the SEV
N = sample size
n/a = not applicable; all concentrations were detected (FOD = 100%)
SEV = screening ecotoxicity value

[a] For hardness dependent screening SEVs, the hardness value used for the screening evaluation was the sample-specific value or, when a sample-specific value was not available, the arithmetic mean of hardness measurements (66.89 ± 4.5 mg/L $CaCO_3$) collected between 2000 and 2006 in conjunction with the Ecology water quality monitoring was used (the raw data will be presented in the screening level ecological risk assessment). The value shown in the SEV column represents the SEV adjusted to a hardness of 66.89 $CaCO_3$.

[b] USEPA. 2006. National Recommended Water Quality Criteria. Office of Water. U.S. Environmental Protection Agency, Washington, DC. Available online at: http://www.epa.gov/waterscience/criteria/wqcriteria.html

[c] Ecology. 2006. Water Quality Standards for Surface Waters of the State of Washington, Chapter 173 201A. Amended November 20, 2006. Publication No. 06 10 091. Washington State Department of Ecology, Olympia, WA.

[d] Confederated Colville Tribes. 2004. Water Quality Standards. Title 4 Natural Resources and Environment, CH. 8 9. Available at: http://www.narf.org/nill/Codes/colvillecode/cc4ch8to9.htm.

[e] STI (Spokane Tribe of Indians). 2003. Surface Water Quality Standards. March 7, 2003. Resolution 2003 259.

[f] CCME. 2007. Guidelines for the Protection of Aquatic Life. Canadian Council of Ministers of the Environment Canadian Envrionmental Quality Guidelines. Environment Canada. Available at: http://www.waterquality.ec.gc.ca/EN/navigation/3297/3301/3307.htm

[g] Value represents acute criterion for silver because no chronic criterion is available

MAPS

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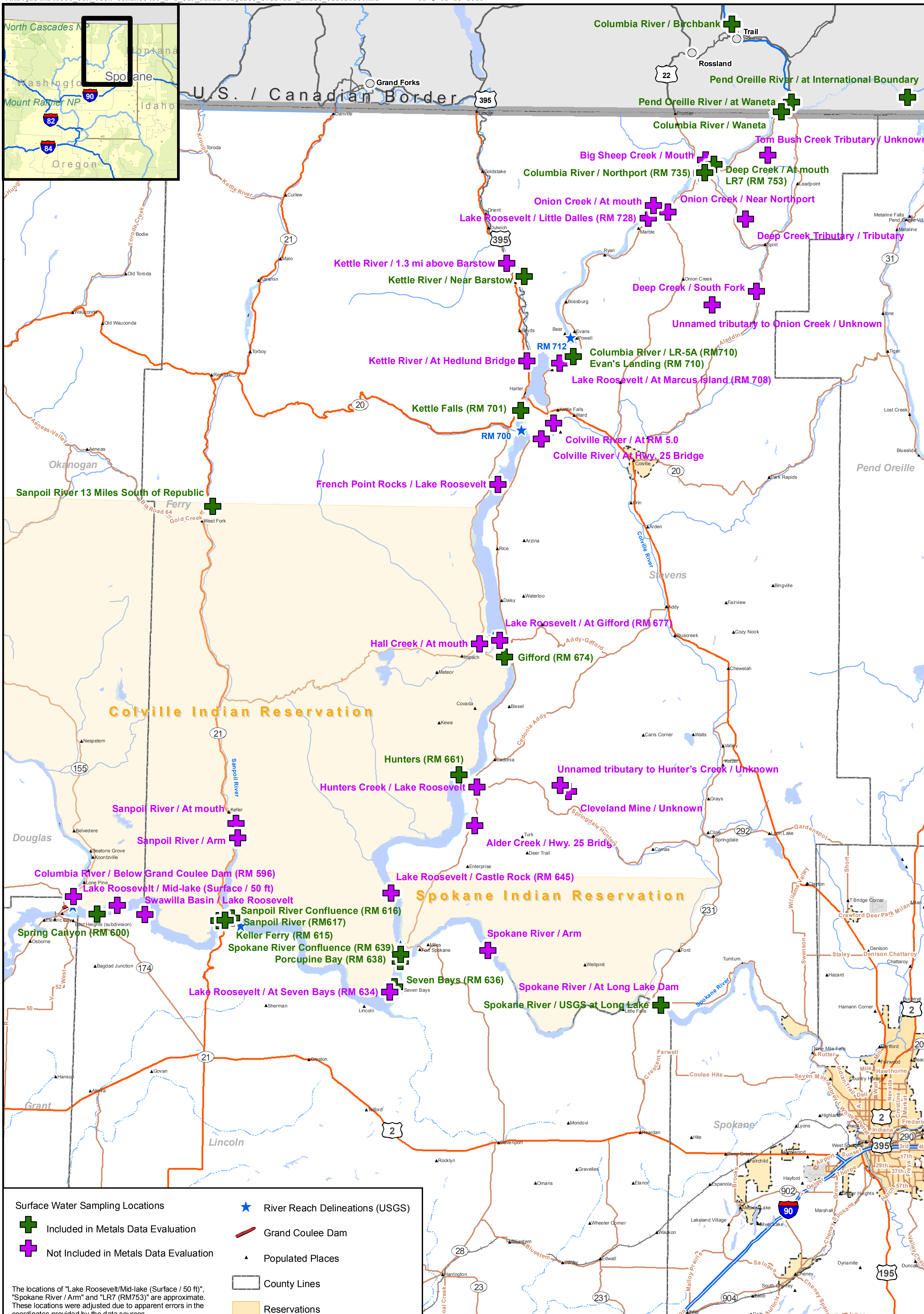

Integral Parametrix

Map 1. **Surface Water Metals Sampling Locations in the Study Area and Vicinity**

Upper Columbia River, WA

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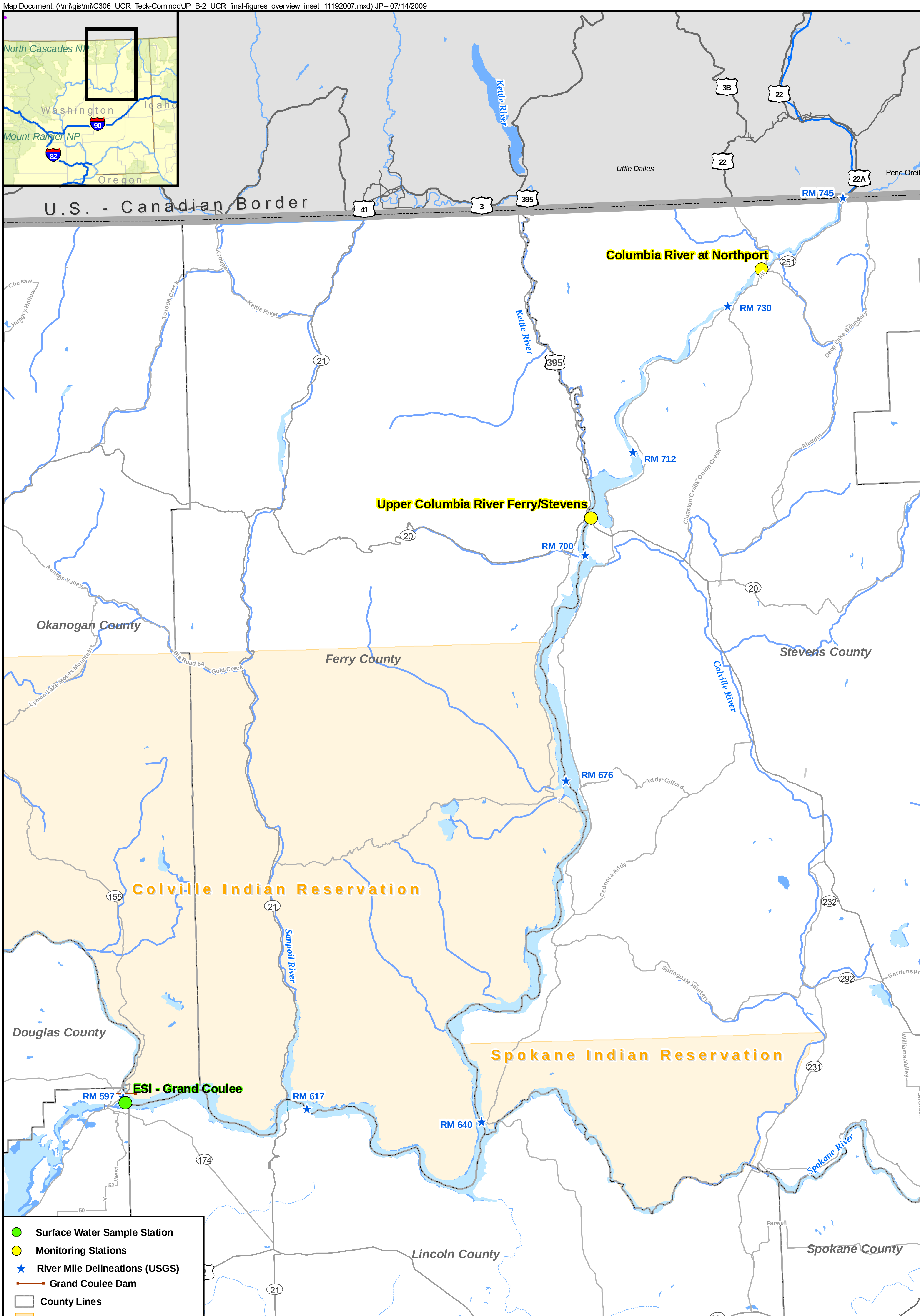

Integral Parametrix

Km 0 5 10

Miles 0 5 10

N

Map 2. **Surface Water Organic Compounds Sampling Locations in the Study Area**

Upper Columbia River, WA

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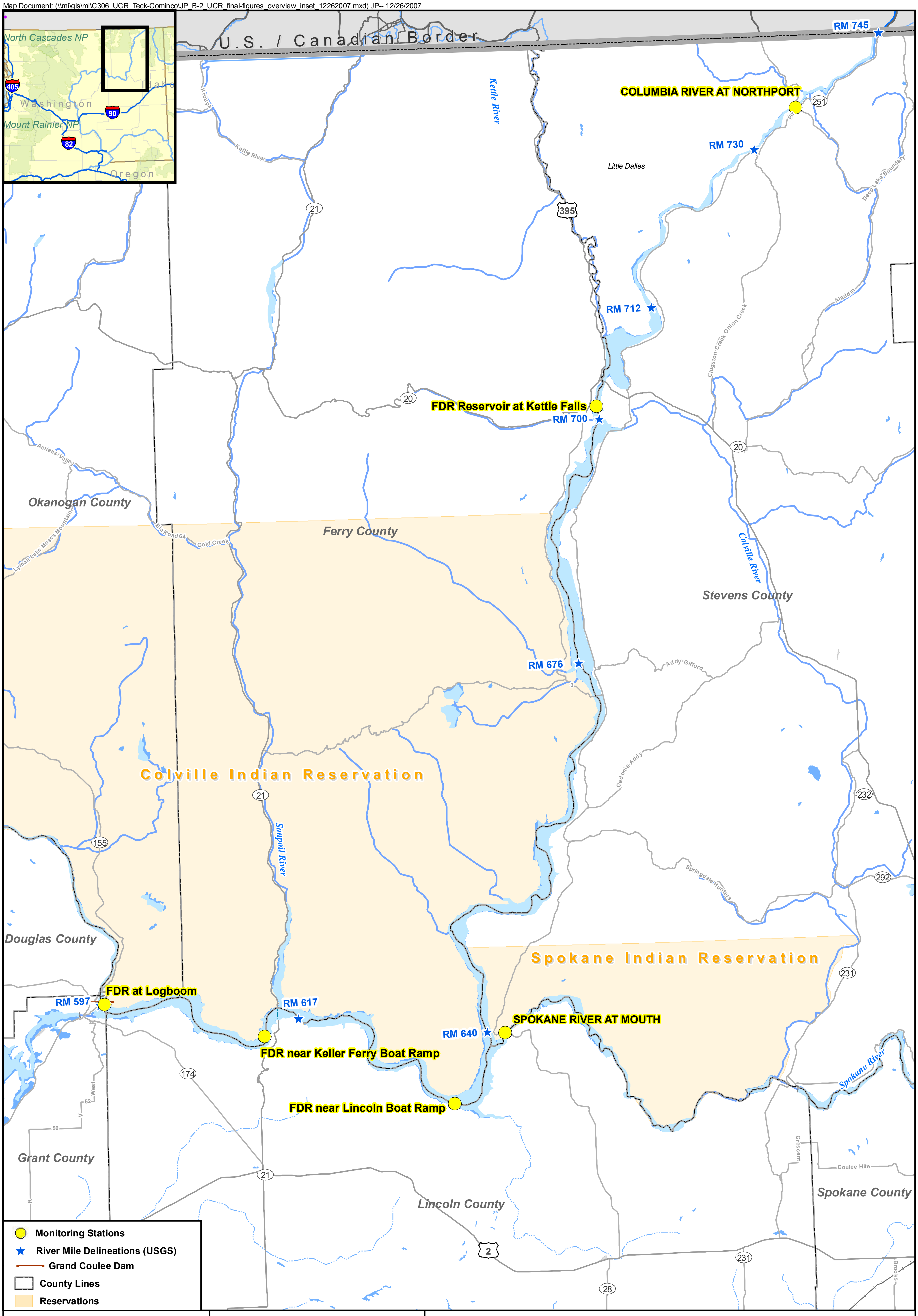

Integral Parametrix

Km 0 5 10

Miles 0 5 10

N

Map 3. **Surface Water Conventional Parameters Sampling Locations in the Study Area**

Upper Columbia River, WA